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Pump and Steam Plate Embossing Press.

With this we present engravings of an embossing press, and of a pump to be used in connection with an accumulator for working hydraulic presses of various kinds. The pump, as will be seen, is belt-driven, the crank working in a "slotted crosshead," which is connected to two plungers, one on each side. The peculiar feature of the pump, however, is the provision for stopping its action automatically, when the desired pressure is reached. The predetermined pressure, when it is attained, is made to raise a rod, which is placed within the suction pipe in such a way that, as it rises, it comes into contact with the under side of the valve, and thus prevents its seating, with the result that, although the motion of the pump continues as before, no water is pumped into the accumulator, and no work is done by the pump until the pressure falls below the desired limit, when the valve is automatically allowed to seat, and water is again pumped.

The weight shown outside the case is adjusted on the lever to the desired pressure. The usual loose pulley is provided for use, when for any reason it is desired to stop the motion of the pump.

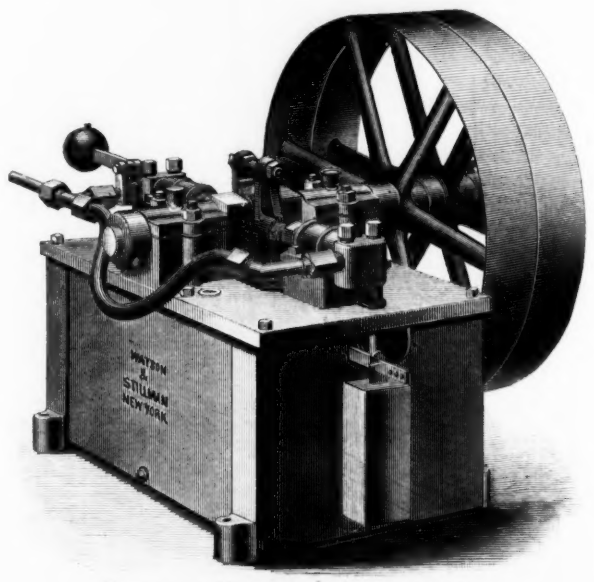
The embossing press is designed especially for making wood panels. The lower platen is raised by hydraulic pressure, there being an 18" ram beneath, capable of exerting a pressure of 350 tons. The ram has an extension below, reaching nearly to the floor, and working through a closely fitted bearing. This portion is large enough for strength merely, and gives steadiness to the motion of the ram. The packing is at the extreme top, and is so arranged that, by lifting off the sliding plate, the packing can be renewed or replaced without the necessity for removing any other parts.

The work done on this machine is intended for an imitation of hand carving. A carving is taken, and from it a casting made in the form of a plate, which makes one die, the other being the reverse. The work is composed of very thin veneering, some sheets of which are placed each side of binders' board, to which they are attached by water-proof cement.

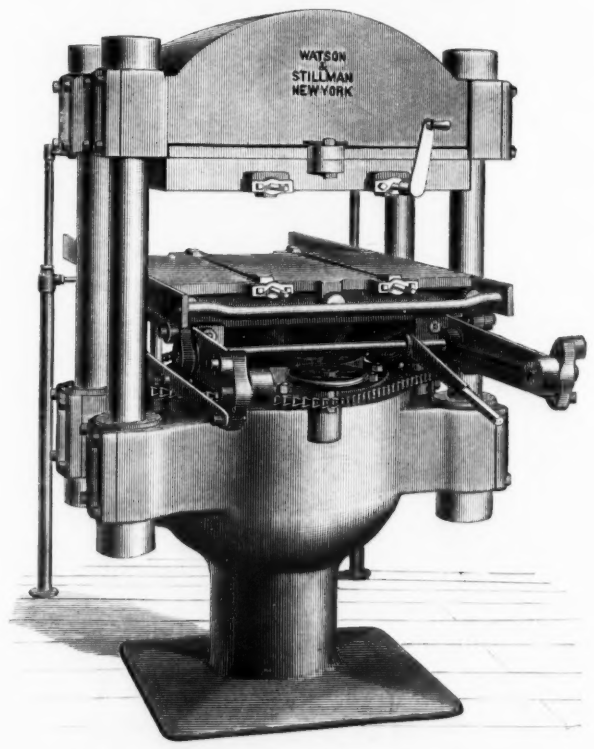
The dies are clamped upon the upper and lower platens, and the lower one adjusted to make them come together properly. As the work must be done hot, both platens are heated by steam, which is supplied through the pipe shown at the left, the connection between the pipe and the movable platen being by a pipe having a joint which allows for the movement, and obviates the necessity for rubber hose, etc.

The sliding plate, upon which the work is placed, rests upon the movable platen when the pressure is on, but when it is to be withdrawn, the short lever shown in front is depressed, whereby six rollers (three of which are on each side) are raised, lifting the sliding plate from the movable platen. It is then drawn out, running upon the rollers.

In order to give to the movable platen no more motion than is needed for the particular job in hand, there are four screws, one under each corner, upon the top of which the platen rests when it comes down. These screws are all turned together by means of a chain which passes around a gear in front, which is turned by the hand-wheel shown. The stud upon which the gear and hand-wheel works is in two parts, the lower part, which enters a hole in the bed, being eccentric to the other, so that, by loosening a set screw and turning it partially, the chain can be tightened. By turning this hand-wheel one way or the other, the point to which the platen shall descend can be fixed to suit the job in hand, and thus no more time nor water consumed than is necessary.



PUMP FOR HYDRAULIC ACCUMULATOR.



STEAM PLATE EMBOSSING PRESS.

A non-conductor of heat is interposed between the lower platen and the ram to which it is attached, to prevent the burning of the press packing by the heat from the platen.

These machines are built by Watson & Stillman, New York City.

It is proposed to connect the search lights of war vessels with the sights of quick-firing guns in such a manner that, when the light is bearing upon an object (a hostile torpedo boat, for instance,) the gun is also bearing upon it. The object is to save time when every minute is of the utmost importance.

The Modern Steam Plant and its Management.

BY PETER H. BULLOCK.

In a former paper the consumption of fuel per square foot of grate surface per hour was spoken of, with the remark that the best practice of to-day was to burn more than formerly. The wide difference in conditions between different parts of the country, such as quality of coal, difference in the construction of boilers and furnaces, and in modes of firing, make comparisons one with another very difficult, but it may be stated as a fact that more perfect combustion of the fuel and gases will be had in a furnace run at a high temperature than in one where the combustion is slow.

The writer made inquiries of various parties as to the amount of fuel they were using, figured on the basis of pounds per square foot of grate, and hours, and the replies indicated either a remarkable difference in the amount used, or else very serious errors in the figures. Certainly the latter in one case, where the hours were given as ten, which was the time the mill run for the operatives, but I learned incidentally that steam was made and used mornings, noons, and evenings for other purposes. With these explanations, which spoiled the value of the figures, it was easy to see how the result of thirty-three lbs. per hour was arrived at. Another claimed less than five lbs. per hour but reckoned all the time from starting the fire, at 5.30 in the morning, till 6.30 P.M., when it was all burned out. As this time includes an hour at noon when the furnace is closed up, and some two hours before and after regular working hours, these figures, too, are of little value for comparison with others where the data was taken with greater care.

Several large corporations and institutions having the best appliances report that they burn from ten to twenty-eight lbs. per hour; the latter in a case where the heating surface was large in comparison to the grate, and the fuel used a mixture of hard coal screenings and soft coal with a forced draught. With clean hard coal several report burning from fourteen to twenty lbs., and with soft coal from twelve to twenty-three lbs., one experienced man claiming to get the best results in pounds of water evaporated per pound of coal at the latter figure. The gentleman who gave the very low figures, and who was proud of his plant, also gave other data regarding it, that seemed to be as remarkable as the low rate of combustion. Out of curiosity, the writer made a few simple tests with quite amusing results. These we will refer to when we discuss the use of steam in the engine.

There are several things in the management of furnaces about which men will differ, and some will favor methods that a little thought on their part would show them to be wrong, both in theory and practice. Take for instance the wetting of fuel, with the idea that there is a gain in heat from the decomposition and combustion of the gases of which water is composed. When wet fuel is put into a furnace the water simply passes off as steam, with the other products of combustion, and is of no benefit to the fire as a fuel. It is a benefit however to slightly wet dry and dusty fuel, but the gain comes from the following causes: First, less of the fine dry coal passes off in a cloud of black smoke; second, there will be less deposit in the tubes or on other parts of the heating surface; third, the coal will more readily coke than when dry; and finally, it is more safe and comfortable to fire than when dry and dusty.

Probably most engineers have found by experience that few things are more explosive than a shovelful of dry and pulverized soft coal when thrown loosely into a hot furnace. Slightly dampen dry coal for the above reasons, but if you wish to decompose and burn water, get a scientific man and his

apparatus for the purpose, instead of trying it yourself in the furnace. You will find it cheaper to evaporate the water inside your boiler than under it.

Opening furnace doors to keep down steam is another bad practice, and should only be resorted to in emergencies, as when steam is unexpectedly shut off. All regular stops can be anticipated, and the steam kept from blowing off by other methods, such as covering the fire with fresh fuel, closing the drafts, and pumping in an extra amount of water. The evils of opening furnace doors are not alone confined to the effects of the cold air on the boiler, but are equally bad for the grates, especially if the fire is clean, in which case the incandescent coals will heat the bars, and sometimes so much as to sag and ruin them. This is presuming, of course, that ash-pit doors are closed, which is usually the case when the furnace doors are opened for the above purpose.

In case of one or more boilers where steam is already on, and it is desired to raise steam on another, it is best to allow the pressure to accumulate until it is equal to that in the boilers the steam is already on; still I do not consider there is any absolute danger from letting steam from a higher to a lower pressure, provided the valve is opened slowly. The writer once opened a valve from a boiler with eighty lbs. pressure to one with forty-five lbs. One and a half minutes was taken to equalize the pressure, which was sixty-eight lbs., and the water had raised one inch in the boiler that had the lowest pressure, part of which probably went over with the steam, and a part was the result of condensation, owing to the lower temperature. There can be no more injury to the boiler with the higher pressure than if the steam was taken for any other purpose, and the only bad effect it could have on the other would be the unequal expansion in those parts of the shell above and below the water-line, and as the expansion of iron between the two temperatures is very little, the strain would be correspondingly small; still it is far better to avoid those small strains, and have the pressure equal before connecting.

The fixtures required for safely operating a boiler are quite few and simple, but there are a good many appliances that are useful and convenient, but strictly speaking are not necessary. Such, for instance, as high and low water alarms and automatic valves for regulating the supply of water. There should be a valve in the feed pipe next to the boiler, and a good check next to that, so that if any obstruction gets into the latter, the valve can be closed and the check examined or repaired.

Safety valves and steam gauges of good, bad, and indifferent design and workmanship can be procured, and they will give satisfaction and require attention about in proportion to their cost, unless that has been excessive owing to useless ornamentation or complication.

For ascertaining the height of water, one should never depend entirely upon a glass gauge, but a continual trying of water gauges is unnecessary if the former is properly attached. It is an excellent way to take out the pet cock usually provided at the bottom of the glass, and tap the fitting for a ¼-inch pipe, then put on a valve and run the pipe down and into the ash-pit. With this arrangement there is no need of continually trying the gauge cocks; just open the valve and the water instantly disappears from the glass and steam passes down through it until the valve is closed, when the water will again resume its proper level. This is just as reliable as the gauge cocks, and far cleaner and easier to operate. Where a water column is used, the writer usually runs a ¼-inch drip from the bottom of it to the ash-pit, and connects the drip from the glass gauge into that pipe. This piping should be of brass, with the burrs carefully trimmed from the ends so that a free passage may be had for the water, and nothing left for sediment or dirt to stick to.

Of the different methods for boiler feeding, the steam pump is more generally used than any other. There are numerous makes and styles, most all of which have some special points of excellence. A steam pump, being a machine intended for hard and reliable duty, should possess simplicity of construction and operation, and accessibility to all its parts, for adjustments and repairs. There has been a great improvement during the past twenty years in the latter respect, most builders now making the water ends with swinging studs, and reliable means for regulating the valve motion, and setting out the packing in the water cylinder without removing it. There is no piece of apparatus about the fire-room that shows good or poor treatment as quick as the average well-made steam pump.

Fig. 5.

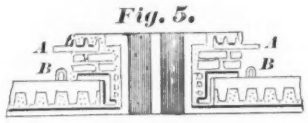


Fig. 2.

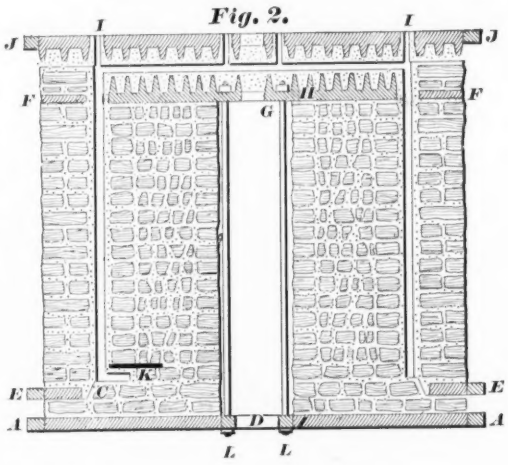


Fig. 1.

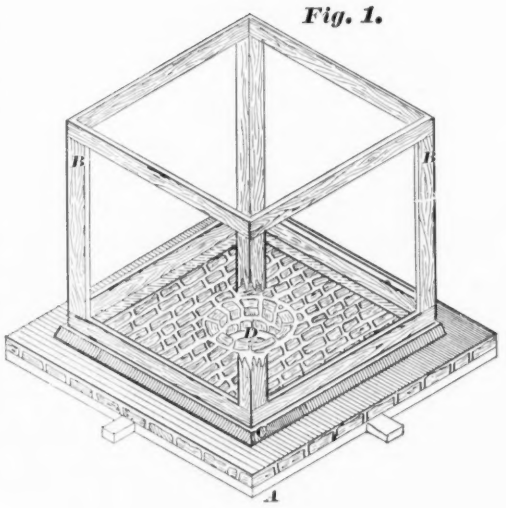
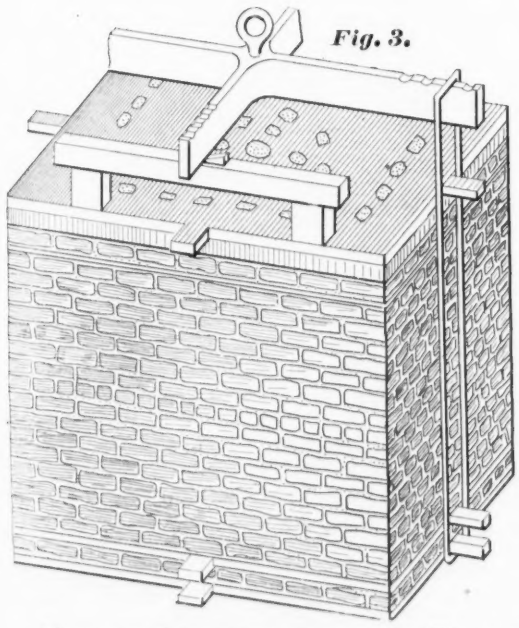


Fig. 3.



You enter another fire-room and see the water gradually going down, but the man is watching it—he wants it to go down just as low as it is safe to have it, before he opens the circus with the pump in the corner, that has a very dirty and battered appearance. Now he goes and opens the steam valve with a whirl, there is a groan, and the piston jumps over to the other end of the cylinder, and a little further than the usual travel. Of course this wedges the unworn part of the rod into the packing, and it sticks there. The valve stem is then pulled, kicked, or struck with a battered monkey wrench, until, either from the jar or some other remote cause, the rod lets go, and it makes a few lightning-like strokes from end to end, but without any water. Then some well-tried expedient at priming will be resorted to, and the thing will settle down to work, and it won't be stopped, either, till there are a few buckets full in the dome. It is too much trouble to start that pump, to stop it, as long as there is room for any more water.

Now these two pumps were just alike when they were put into their respective places; all the difference has been in the way they have been taken care of. The latter has been packed with hard, coarse material, that has worn the rod, making it stick at the ends of the stroke, and also leak air, and lose its suction the moment it is stopped. The steam cylinder often goes without oil for hours, and then again it will get a copious supply of good machine oil, which is about as good for the purpose as Fink's whitewash is for lubrication. There is no better indicator as to how a steam plant is taken care of than the condition of the steam pump or other boiler feeding apparatus.

Fig. 6.

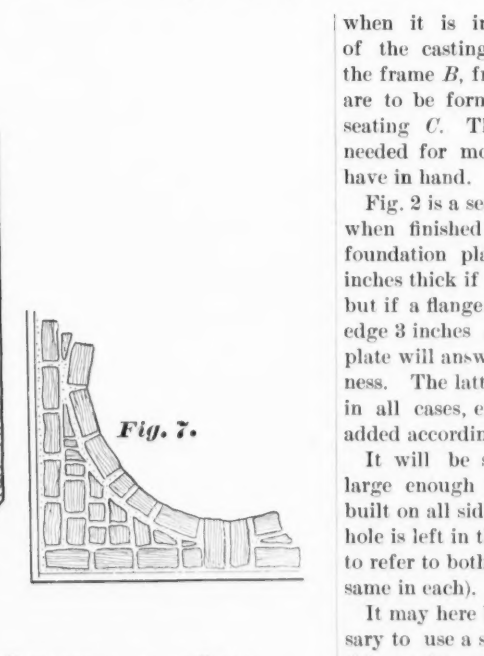


Fig. 4.

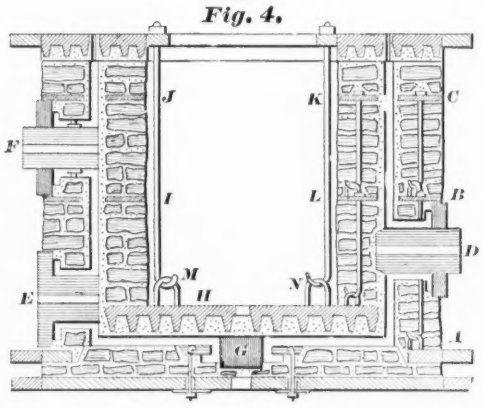


Fig. 7.

MOULDING CONDENSERS, TANKS, HOT WELLS, CISTERNS, ETC., IN LOAM.

Moulding Condensers, Tanks, Hot Wells, Cisterns, etc., in Loam.

BY S. BOLLAND.

The castings enumerated above vary considerably as to size, shape and thickness, some being square, others oblong, whilst again others are made in the form of an L. Such work is required principally by firms whose business it is to build marine and stationary engines, and as such firms invariably have foundries of their own, it seldom finds its way into the jobbing shops. Not unfrequently the latter firms, should they receive an order for anything in this line, will sublet it to some engine shop, believing that such work is too difficult for them to risk their money upon.

There are large numbers of loam moulders of considerable experience with the spindle and sweep, who would hesitate to start on this class of work without some previous instruction. It is, in part, for their benefit that these directions are offered, although, as will be discovered further on, they are eminently adapted to the student as well.

By taking a square tank or hot well, 4 feet 6 inches square, and the same in depth, and showing how to mould it, we shall master the principles which, with slight modifications, will enable us to make any of the above mentioned castings.

Fig. 1 illustrates the foundation part of this job, when it is intended to cast the bottom of the casting uppermost in the mould; the frame *B*, from which the cope and core are to be formed, rest upon the prepared seating *C*. This frame is all the pattern needed for moulding such a casting as we have in hand.

Fig. 2 is a sectional elevation of the mould when finished and closed together. The foundation plate *A* must not be less than 2 inches thick if it is made plain on both sides, but if a flange is formed all along the outer edge 3 inches deep and 1¼ inches thick, the plate will answer if made 1¼ inches in thickness. The latter is the best foundation plate in all cases, especially when cross-ribs are added according to the strength required.

It will be seen that this plate is made large enough to allow a 9-inch wall being built on all sides, and in this case a 12-inch hole is left in the center at *D*. (It will be well to refer to both figures, as the lettering is the same in each).

It may here be observed that it is not necessary to use a spindle and center to mould this casting; two straight-edges may be set to the correct height, and the bearings swept off direct with a third one. Should there be a spindle, then a parallel sweep may be used for the purpose; in either case the directions given will serve.

After the foundation plate has been set down level, begin by setting thereon one course of brick all over, as shown, on which a bed must be swept to form a bearing for the cope ring *E*. When this has become hard enough, center the frame and mark off its outline, then build another course of bricks inside the line, allowing for a thickness of loam with which to form a joint or

guide, as seen at *C*, Figs. 1 and 2. The bed swept on this course of bricks forms the bottom of the mould, and it is on this bed that the frame is seen to rest at Fig. 1. When forming this guide, be sure to give the requisite taper for quick clearance.

The best method of separating all such joints is to brush oil over the surface and sprinkle thereon a little parting sand. When this is done, bed down the cope ring, as seen at *E*, Fig. 2.

This ring must be strong, with the lugs made to correspond with those on the foundation plate, as shown at Fig. 3.

Before commencing to build the cope, brush a little oil over the frame, to prevent the loam from adhering to it ; and in laying the bricks, observe the rule to keep them half an inch back from the surface of the mould. The strickle for sweeping out the spaces will serve as a guide in building.

As shown at Fig. 2, the brick-work is continued as far as *F*, at which place a binding ring is set on. This ring serves two purposes ; it prevents the mould from splitting when it is being lifted, and also stiffens the wall sufficiently, in this case, to prevent damage from ramming. When the walls are deeper or longer than those under consideration, more of the binders are needed ; and it may be found necessary, in some cases, to still further strengthen them by bolting the upper to the lower plates, as seen at *A*, *B* and *C*, Fig. 4.

The remaining courses of brick over the binding plate are set so as to leave half an inch for loam, with which to finish the walls true to the top edge of the frame. When this has been done, and the spaces swept off as correctly as possible, the frame must be withdrawn and the cope lifted away.

After replacing the frame, proceed to build the core after the manner shown at Fig. 2. Form a 9-inch course along the outside and a circle at the center, corresponding to the hole in the foundation plate, which is 12 inches, and set in halves and pieces of brick between. Leave wide spaces for fine cinders to be packed in ; this forms a continuous vent from circumference to center at each course of bricks all the way up. It is best to bed all the bricks on mud, and (excepting next the casting) use no more than is necessary to give a firm set to the bricks ; this, in conjunction with the cinder packing, gives solidity to the core, and enables it to withstand the pressure exerted against the sides when the mould is poured. Again, these cinders will be found serviceable when you dig out the core immediately after casting, which would require to be done in this case if the tank was under $\frac{3}{4}$ inch thick. But the one under consideration, being one inch in thickness, there is no danger on account of shrinkage, if the instructions are faithfully followed ; especially remembering to allow wide spaces between the bricks endways of the walls of the core.

The 12-inch hole left in the middle of the core will be a great help in drying, if the hole in the center of crown plate be left open, which it must be until the mould is placed in the pit for closing ; it can then be filled with brickbats and cinders up to the plate at *G*, and then finished by inserting a dried plug of loam.

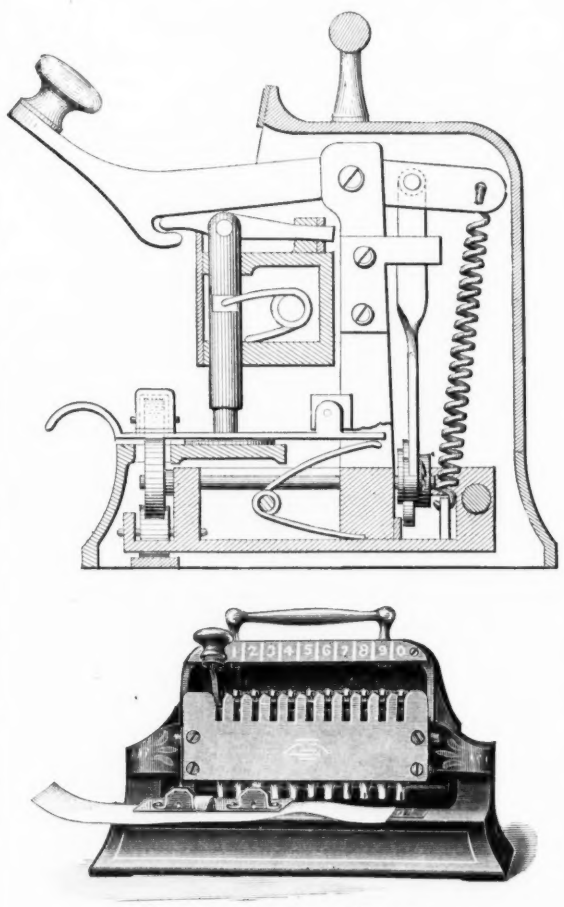
The crown plate *H*, for a job of this kind, would require to be $\frac{3}{4}$ inch thick, and one inch clearance on all sides. The prickers seen are three inches long. Let plenty of holes be cast in the plate to allow the gas from the upper surface to pass freely to the center of the core. To do this effectively it is best to rest only six inches of the outside of the plate on mud or loam ; this will serve to bind the core, the rest will do of fine cinders. The connection is then made by filling more cinders amongst the prickers to the depth of an inch, and if the casting must be run on the crown, as is sometimes advisable, cover with the regular loam mixture, pressing in dry brickbats to absorb the moisture.

In very thin bottoms it is always best to run on top, spreading the gates from the center, as seen on covering plate, Fig. 3. In the event of running all the iron down the sides, as at *I*, Fig. 2, the loam for the crown should be made very open and weak, water in some instances being preferable to clay-wash for making the loam with ; for, should the surface be close and hard, the metal will sometimes refuse to rest on it quietly, and then bubbles ensue. After striking out the top and side spaces as before directed, and after the core has hardened well, take off the frame and finish in the ordinary way.

The covering plate for this job is shown in section at *J*, Fig. 2 ; it is also seen in position at the view of closed mould, Fig. 3. Any further explanation of this plate, other than is to be got from a study of the views mentioned, would be superfluous. Suffice it to say, be sure to have it strong enough, in this instance not less than two inches thick.

To prepare this plate, it may be either swept with the spindle or struck off to straight-edges, dry sand facing being rammed on it rather than loam, as the latter leaves a hard surface, against which the metal does not always rest kindly, as is the case when the former mentioned material is used.

Fig. 3 fully explains the closing and securing of this mould ; one of the four slings is seen in position, also one set of packings under the cross. When all four sides are



THE LOWDEN BANK PUNCH.

packed thus, eight places are caught instead of four. By adopting this method, the plate is prevented from springing. Additional props can be introduced at any other point where it may be considered advisable, either singly or by the combination shown.

To carry off the gas generated in this core when the mould is poured, let a trench be dug, 12 inches wide, from the center of the bed on which the core is to rest, to the walls of the pit. Have this trench filled with cinders or ashes, and connect with a pipe, which will reach the top of the pit, if the whole pit is to be rammed ; but if curbs are used in which to ram the mould, escape for the gas may be provided for by leaving the end of the trench uncovered. There is absolutely no danger of an explosion with a core built as herein directed, and the trench prepared as above.

So far we have only been moulding a plain casting ; we will now inquire into the mode of procedure where branches, flanges, brackets, etc., are added.

Sometimes internal flanges are required, as at *K*, Fig. 2. These must be made loose, and set to place when the frame has been set back on the bed to build the core. In the event of such flange not exceeding three inches wide, a course of bricks, laid endways over it, will be all that is needed to carry the wall above ; if wider than three inches, lay an iron rod alongside each brick, of a length sufficient to act as a counterbalance to the weight over the flange.

In the case of a plain casting, it is unnecessary to bolt down the core, but when flanges are introduced as described, an anchor of some kind is indispensable. For all ordinary cases the method shown at *L* will answer the purpose, but should the flange be required of ordinary width, the increased pressure at that part would necessitate extra precautions to resist it, otherwise the core will rise and the casting be lost. In such a case the bottom bed must be struck wide enough for the flange, a pattern for which can be dispensed with by simply making a temporary frame, as high as the thickness of flange, with which to form a bearing for the covering plate.

This covering plate must be prepared to set over the flange when finished, and bolted securely to the foundation plate, through holes cast to correspond with each other in both plates.

When branches, brackets, etc., are to be cast on the tank or hot well, the patterns of such may be secured to the frame by inserting a cross-bar, on which to screw them fast, then build around in the regular way. Fig. 4 shows three branches, *D*, *E*, *F*, drawn for the purpose of explaining as many different methods of setting in the core and covering cake. In all three it is seen that a guide bearing for the covering cake is prepared true to the face of flange; this bearing may be a part of the pattern, or it may be swept by a strickle, kept in position by a center pin.

At *D*, the covering cake is first set up and made fast ; the core is then to be pushed through until the end is firmly fixed into the seating prepared for it in the body core.

At *E*, the covering cake and core are in one piece, whilst at *F* the core is supposed to have been centered by chaplets or studs, and the covering cake slipped on last. All of these methods will be found equally applicable, according to the circumstances which govern the job in hand.

If a branch be required on the bottom of the mould, it will be found easy of accomplishment, if the method shown at *G*, Fig. 4, be adopted. It will be seen that the space betwixt the flange and the body of the casting is blocked out, and a core inserted to form such space. This core may be secured in many ways, but the one shown, bolting to the foundation plate, is the safest.

When branches come on the top, the method illustrated at Fig. 5 will be found the most simple. Have the hole in the covering plate made large enough to slip over the flange of the branch easily (this obviates the breaking of the covering plate), and when this has been swept, finished and dried, let it be turned over and set on the joint of the cope before it (the cope) is lifted off the seating ; the pattern for the branch in the meantime having been secured to the frame by means of the cross-bar alluded to above, and propped underneath. A few cranked irons, as seen, will serve to carry the loam and bricks, with which the wide space is filled, over which the building can be continued to the top. If for any reason it should be required to turn the top plate over again, the brickwork round the branch can be secured to the plate, by using another plate made to rest thereon, with lugs *A* having holes cast in to correspond with staples *B*, cast in the covering plate, and by this means binding all together with hook bolts.

Before lifting off the covering plate, let guide marks be made, to insure the correct closing of the mould.

To make this casting with the bottom down, as seen at Fig. 4, we must make an entire change in the methods of working, as will be observed if Fig. 4 is studied carefully.

In this case, when the cope or outside has been built and lifted away, the bottom of the mould must be swept off and finished, and when this has sufficiently hardened, a bed of sand, equal to the thickness required, must be rammed over it ; also let the bottom plate *H* be prepared and dried, after which it is turned over and laid central on the thickness. The frame is then replaced for building the core. As seen, this core is not built solid ; a 9-inch wall will serve the purpose, if binding plates are set in, as shown at *I* and *J*. These binders are needed to help resist the pressure which comes against the walls when the mould is in cast. In larger castings it is important that greater strength be imparted to the walls. This may be done by bolting the binders together, as at *K* and *L* ; and in the case of very extended surfaces it will be necessary to prop each side to its opposite, by an arrangement of studs or joists, firmly wedged in.

In some jobs it is possible to obviate very much of this bolting and staying, by building an inside course of bricks to a true circle, and filling in the corners with open brickwork and cinders, as shown in plan at Fig. 7.

The lifting staples, two of which are shown at *M* and *N*, are set to come under the holes cast in the inner lugs of the covering plate ; a plan of which plate is shown at Fig. 6.

The core is to remain resting on the thickness, until the whole mould is finished and dried ; the cope is then closed over the core, the covering plate brought into position, and the core firmly bolted up to it. The whole is then to be lifted off the seating by hitching to the cope ring, and when the sand thickness has been removed, lowered back in its place.

It will be readily seen that, to make these castings in the manner treated of last, all the plates and rings must be made much stronger than is called for in the former case, because the covering plate sustains the core, the cope ring must lift cope, top plate and core, and the bottom plate and cross must resist a pressure equal to four times the amount exerted in the former instance.

The Lowden Bank Punch.

In drawing a check, draft or bill of exchange, it is, of course, desirable to mark it in such a manner that the amount cannot be changed or raised ; and as the law makes the drawer of the check or draft responsible if he fails to use all the means at hand to protect the same from fraudulent alteration, the use of check punches is constantly increasing, and by many are considered a necessity. Accompanying this are engravings which show the appearance and construction of the Lowden bank punch, a machine which has recently been placed upon the market, and which, while it embodies the essential features of other machines of its class, has some which are peculiar to itself, by which the feed is made automatic and positive, and the operation quite rapid.

The machine consists essentially of an outer frame or casing, in the front part of which is a row of eleven punches, which may be pressed down through corresponding openings in a steel plate below, which answers as the die. Inside the frame is a small carriage, to which is attached the hand lever shown. To the same carriage is hinged a thin plate, which carries two small rollers. This plate is pressed down by the action of a spring, and may be lifted by the finger when the paper to be punched is placed under it, where it is held between the two rollers and a third one, which is underneath, and is called the feed roller. This feed roller is turned slightly during the upward movement of the hand lever, after being depressed, and thus the paper is carried forward sufficiently for the succeeding space. The carriage carrying the lever, the guide and feed

rolls, and the paper, can be moved along from side to side, so that the lever, when depressed, will carry down with it the desired punch, the character of which is indicated by the numbers placed upon the frame above. In operation, after the paper has been put in place the hand lever is moved to the extreme left and depressed, which punches out the $ mark. As it rises, the paper is automatically moved along for the next space by the rollers, and the lever is then moved to any other desired figure, of course carrying the rolls and the paper along with it. It is again depressed, and the operation is repeated until all the figures are punched out, when it is returned to the left and the $ mark repeated, to prevent other figures being added. The vertical plate in front has slots in its upper edge, into which the lever fits, and as the upper ends of these slots are enlarged to make the lever enter them easily, they serve to center it accurately over the given punch, and thus bring the paper into the exact proper position. Fig. 2 is a vertical cross-section of the machine, from which its construction and operation will readily be understood. It is muanufactured by The Hoggson & Pettis Mfg. Co., New Haven, Ct.

Practical Drawing.

BY J. G. A. MEYER.

SIXTY-NINTH PAPER.

532. In Fig. 426 (last paper) we found the length of the straight line $l\ m$ by laying off on it a number of equal spaces $l\,2l$, $2l\,3l$, etc., and since the length of the line $l\ m$ represents the whole length of the development, we made the number of spaces on $l\ m$ equal to twice the number of spaces laid off on the semi-circumference of the ellipse in Fig. 424 *A*. This way of finding the length of the line $l\ m$ is the simplest one, and in many practical cases it will give results sufficiently accurate, provided the spaces laid off on the circumference of the ellipse are small, say not exceeding 1 or 1¼ inch in ordinary boiler work; in fact, the greater the number of spaces, the nearer will we approach the true length of the line $l\ m$. In this manner we can obtain a degree of accuracy which will satisfy all practical cases; yet theoretically, the length of the line $l\ m$, obtained in this way, will be somewhat short, as explained in Problem 58. It may therefore be sometimes desirable to find the length of the line $l\ m$, or, in other words, the development of the circumference of the ellipse, by calculation.

The following rule has been taken from the Civil Engineers' Pocket-Book, by J. C. Trautwine. Add the squares of the major and minor axes, divide this sum by 2, and call the quotient *A*. Next subtract the minor axis from the major axis, and square the difference; divide this square by 8.8, and subtract the quotient from *A*; take the square root of the remainder, and multiply this square root by 3.1416; the product will be the required circumference, or the length of $l\ m$. Representing this rule by symbols, we have,

$$\text{Circum.} = 3.1416 \sqrt{\left(\frac{D^2 + d^2}{2}\right) - \frac{(D-d)^2}{8.8}}$$

Where D = major axis,
d = minor axis.

Example: Let the length of the major axis be 4 feet, and the length of minor axis 3½ feet, then the circumference of the ellipse will be

$$3.1416 \sqrt{\left(\frac{4^2 + 3.5^2}{2}\right) - \frac{(4-3.5)^2}{8.8}}$$

$$= 3.1416 \sqrt{\left(\frac{16 + 12.25}{2}\right) - \frac{.25}{8.8}}$$

$$= 11.781 \text{ feet.}$$

If D exceeds 5 times d, then, instead of dividing $(D-d)^2$ by 8.8, divide it by the number in the following table.

D =	Divide by	D =	Divide by
6 d	9	20 d	9.8
7 d	9.2	25 d	9.87
8 d	9.3	30 d	9.92
9 d	9.35	40 d	9.98
10 d	9.4	50 d	10.04
12 d	9.5	60 d	10.10
14 d	9.6	70 d	10.17
16 d	9.68	80 d	10.23
18 d	9.75	100 d	10.35

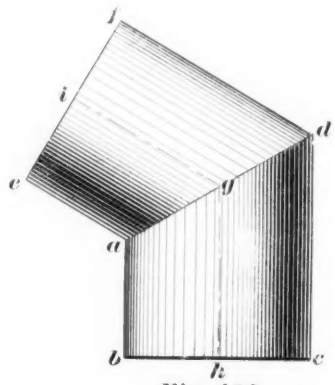


Fig. 430.

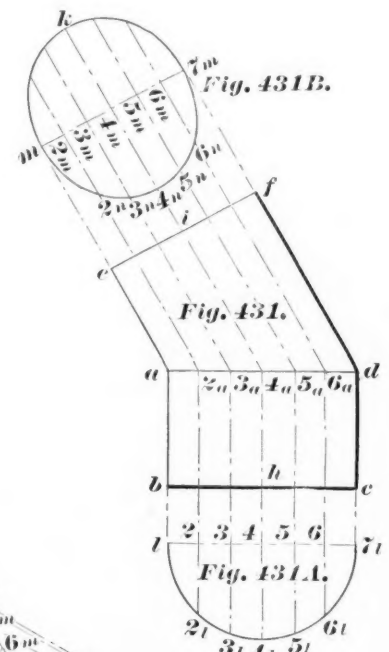


Fig. 431B. Fig. 431. Fig. 431A.

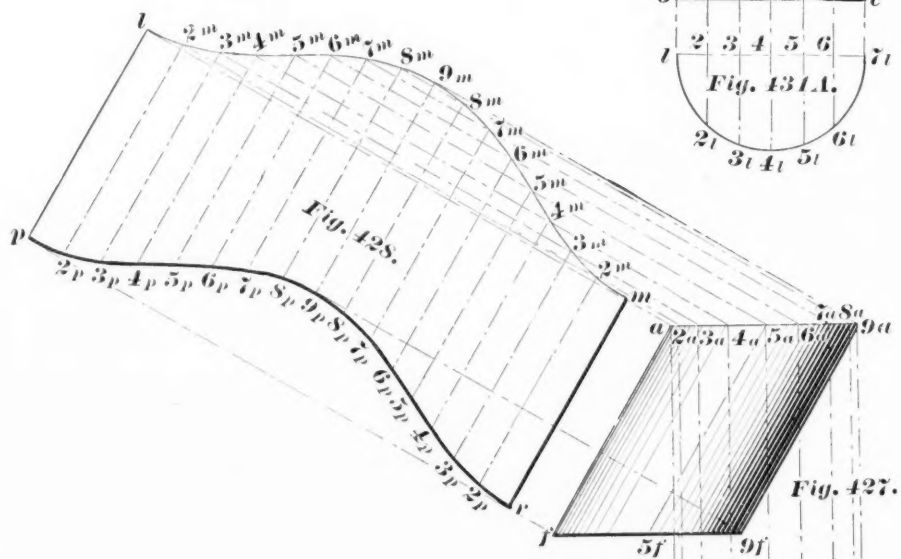


Fig. 428. Fig. 427.

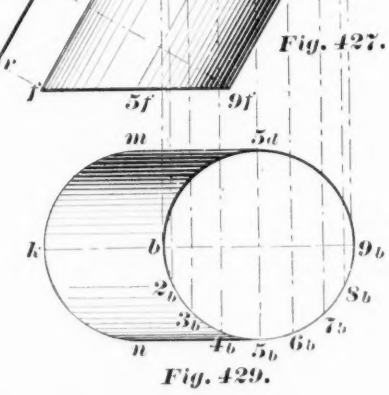


Fig. 429.

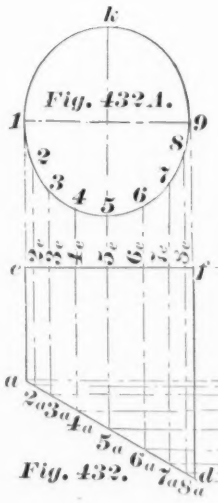


Fig. 432A. Fig. 432.

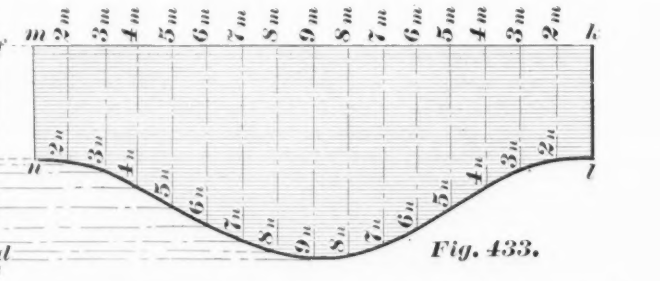


Fig. 433.

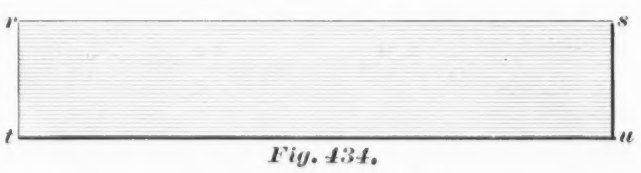


Fig. 434.

533. *Second method of finding the development of the cylindrical surface of any oblique cylinder.*

Let *a* 9*a*, *f* 9*f*, Fig. 427, be the vertical, and *k* 5*d* 9*b* 5*b* the horizontal projection of an oblique cylinder; it is required to find the development of its cylindrical surface. Divide the semi-circumference *b*, 5*b*, 9*b* (Fig. 429), in any number of equal parts, say eight; through the points of division 2*b*, 3*b*, 4*b*, etc., draw vertical lines terminating in the points 2*a*, 3*a*, 4*a*, etc., on the base *a* 9*a*, Fig. 427. Through the latter points, and also through the points *a* and 9*a*, draw lines *a l*, 2*a* 2*m*, 3*a* 3*m*, perpendicular to elements of the cylindrical surface, or, what amounts to the same thing, draw these lines perpendicular to the axis 5*a* 5*f*; also through the point *f* draw a line perpendicular to *f a*. At any convenient distance from the element *f a* draw parallel to it the line *m r*, terminating in the line *a l* and *f p*. From the point *m* as a center, and with a radius equal to the arc *b* 2*b* (or any one of the arcs, as 2*b* 3*b*, 3*b* 4*b*, etc.), Fig. 429, describe a short arc cutting the line 2*a* 2*m* in the point 2*m*; from the point 2*m* as a center, and with the same radius as before, describe a short arc cutting the line 3*a* 3*m* in the point 3*m*; in a similar manner find in succession the points 4*m*, 5*m*, etc.; do not change the radius with which the short arcs are described. Through the points *m*, 2*m*, 3 *m* . . . *l* draw a curve; also through the same points draw lines perpendicular to the line *l m*, and make the length of the lines 2*m* 2*p*, 3*m* 3*p*, etc., equal to *m r*; and through the extremities *r*, 2*p*, 3*p*, etc., draw a curve. The surface bounded by the curves *l* 9*m m*, *p* 9*p r*, and the straight lines *l p*, *m r*, Fig. 428, is the development of the cylindrical surface.

Comparing the two methods of finding the development of the cylindrical surface of an oblique cylinder, we notice that in the first method the smallest cross-section of the cylinder must be known; in the second method, the development is found without knowing the smallest cross-section of the cylinder.

534. Again, in Fig. 426 (last paper), the lines *l p*, 2*m* 2*p*, 3*m* 3*p*, etc., are all at equal distances apart; in Fig. 428, the lines *l p*, 2*m* 2*p*, 3*m* 3*p*, 4*m* 4*p*, 5*m* 5*p*, when correctly drawn, are not at equal distances apart.

Measuring the distance between the lines *l p* and 2*m* 2*p* in Fig. 428, we find that these lines are further apart than the lines 2*m* 2*p* and 3*m* 3*p*; the distances between the different lines decrease up to the line 5*m* 5*p*; the distance between the lines 5*m* 5*p* and 6*m* 6*p* will be equal to that between 4*m* 4*p* and 5*m* 5*p*; from the line 5*m* 5*p* up to the center line 9*m* 9*p* of the development, the distances between the lines increase, so that the distance between the lines 8*m* 8*p* and 9*m* 9*p* is equal to that between *l p* 2*m* 2*p*.

535. In Fig. 430 we have shown portions of two cylinders, *a b c d* and *a d e f*, with the plane *a d* of their intersection bisecting the angle formed by the axes *g h* and *i g*; in other words, the line *a d* is drawn in such a position as to make the angle *i g a* equal to the angle *a g h*. In cases of this kind the base *b c* of the cylinder *a b c d* will be equal to the base *e f* of the cylinder *a d e f*; that is to say, if *b c* is a circular base, then *e f* will also be a circular base, and the size of one will be equal to that of the other. Again, if *b c* is an elliptical base, then *e f* will also be an elliptical base, and, of course, both will be equal in size.

In Fig. 431 we have shown two cylinders *a b c d* and *a d e f*, whose plane *a d* of intersection does not bisect the angle formed by the axes 4*a h* and *i* 4*a*, that is to say, the angle *i* 4*a a* is not equal to the angle *a* 4*a h*. In cases of this kind, the base *b c* of the cylinder *a b c d* will not be equal to the base *e f* of the cylinder *a d e f*; thus, if the base *b c* is cylindrical, then the base *e f* will be elliptical; in short, the cylinders *a b c d* and *a b e f* will be of different forms or kinds.

Indeed, with a little thought, the truth of these statements should become apparent without any particular geometrical demonstration.

Notice, for instance, the line *a d* in Fig. 431. This line is perpendicular to the elements *a b*, *d c*, and since these elements are at equal distances from the plane of projection, it follows that the line *a d* must represent the true distance between the elements *a b*, *c d*. But the line *a b* also joins the extremities of the elements *a e* and *d f*, and since the line *a d* is not perpendicular to these elements, it cannot show the shortest or the true distance between the lines *a e* and *d f*; the line *e f*, which is drawn perpendicular to *a e* and *d f*, represents the shortest, or true distance between these elements. It must be perceived that, under these conditions, *e f* must be shorter than *a d*; and since *a d* is equal *b c*, it follows that *e f* must be shorter than *b c*. If, now, the base *b c* is a circular one, then *b c* represents the diameter of this base, and the line *e f* represents the minor axis of the elliptical base of the cylinder *a d e f*.

If it is required to find the development of the cylindrical surface *a b e f*, we may, in doing so, follow the first method given in Art. 531; or we may follow the second method given in Art. 533. Probably the first is the most practical one; we will briefly show its application.

536. Let it be required to develop the cylindrical surfaces shown in Fig. 431. Draw the semi-circle *l* 4*l* 7*l* (Fig. 431 *A*); divide the diameter *l* 7*l* into any number of equal parts, say six; through the points of division 2, 3, etc., draw the verticals terminating in the base *a d*. Through the extremities 2*a*, 3*a*, etc., draw lines parallel to center line 4*a k*, and make 2*m* 2*n* equal to 2 2*l*; 3*m* 3*n* equal to 3 3*l*, and so on in succession, thereby obtaining the points 2*n*, 3*n*, etc. Through

these points draw a curve and complete the ellipse *m* 4*n* 7*m k*, which will be the smallest cross-section of the cylinder *a d e f*.

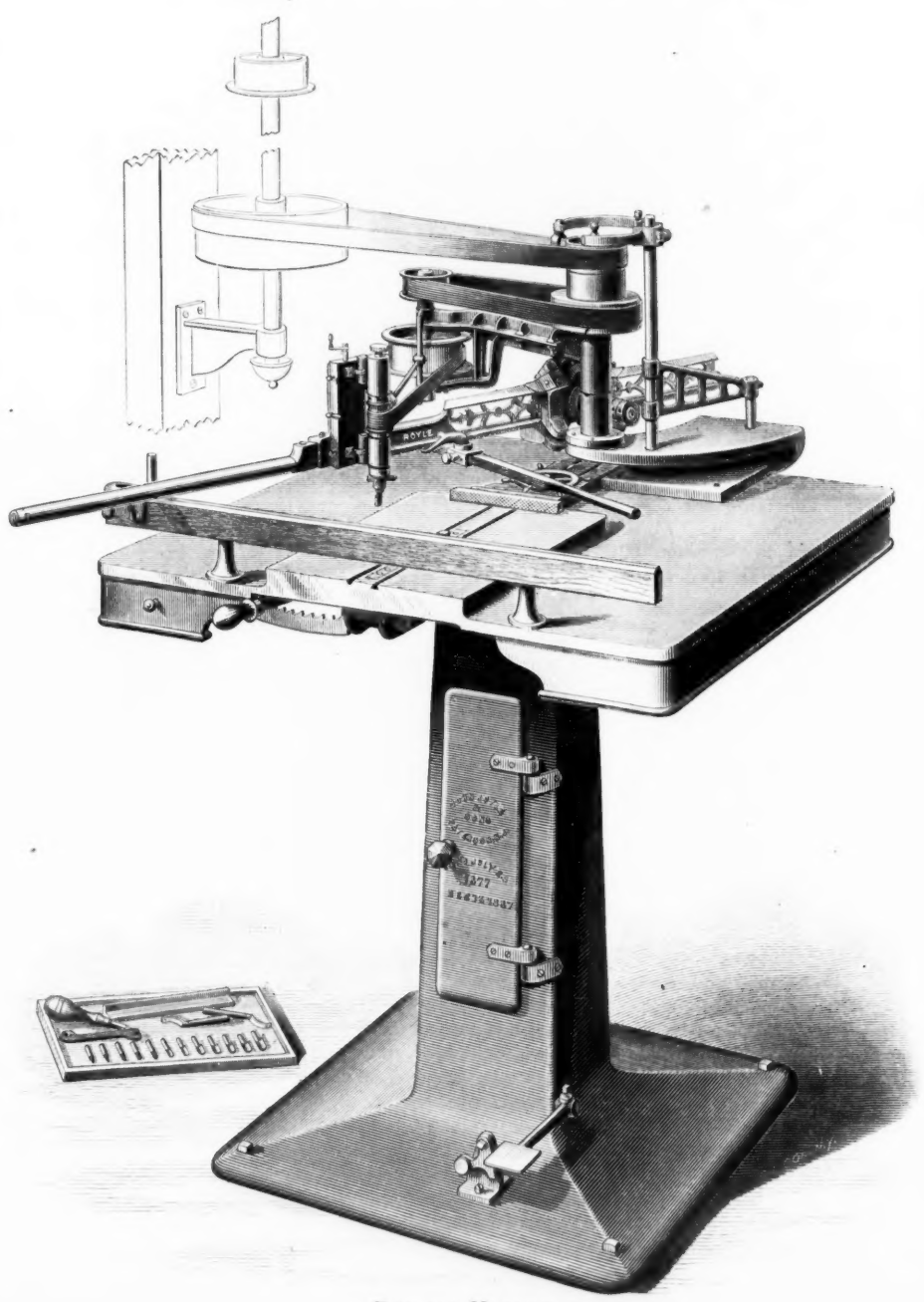
To avoid confusion of lines in what is to follow, draw another elevation of the cylinder *a d e f*, as shown in Fig. 432; also draw its smallest cross-section directly above it, as shown in Fig. 432 *A*; in short, let Figs. 432 and 432 *A* be exact duplicates of the cylinder *a d e f*, and its smallest cross-section, shown in Figs. 431 and 431 *A*. Divide one-half of the circumference of the ellipse in Fig. 432 *A* into any number of equal parts, say eight, and through the points of division 2, 3, etc., draw verticals terminating in the base *a d*. Find the length of the line *m k*, Fig. 433, either by calculation or by laying off on it, in succession, twice the number of spaces as spaced off on the semi-circumference of the ellipse. Through the points 2*m*, 3*m*, etc., obtained by laying off these spaces, draw lines perpendicular to *m k*; make *m n* equal to *e a*; 2*m* 2*n* equal to 2*e* 2*a*; 3*m* 3*n* equal to 3*e* 3*a*, and so on, in succession. Through the points *n*, 2 *n*, 3*n*, etc., draw a curve, and thus complete the outline of the shaded surface, which is the development of the cylindrical surface *a d e f*. If the length of the line *m k* has been obtained by calculation, then divide it into twice as many equal parts as spaced off on the circumference of the semi-ellipse; through these points of division draw verticals, and then proceed as before.

The development of the cylindrical surface *a b c d* (Fig. 431) is represented by shaded rectangular surface *r s t u*, Fig. 434. The breadth *r t* is equal to *a b* in Fig. 431; and the length *r s* is equal to the diameter *b c* × 3.1416.

Comparing the developments shown in Figs. 433, 434, we find that the length *r s* is greater than *m k*; this is as it should be; with a little thought the truth of this statement will become apparent. It should also be remarked that the length of the curve *n* 9*n l*, when straightened out, will be equal to the length of the line *r s*.

Routing Machine.

The accompanying illustration represents a routing machine. The purpose of this machine is to cut down the surfaces which are to be depressed on engravers' blocks, leaving the surface from which impressions or prints are to be taken, in bold relief. The depressions are cut by a vertical cutter, rotating very rapidly; for ordinary work the cutter makes about 12,000 revolutions per minute; for very heavy work this speed is somewhat reduced. These machines are well adapted for routing wood, zinc, brass, or other metals such as are used by engravers, and are designed for routing process engravings, electrotypes, stereotype plates, either blocked or unblocked; brand letter blocks, wood cuts, pine tints, showbill cuts, label work and blocks for the manufacture of fine paper hangings.



ROUTING MACHINE.

The countershaft at the left-hand side of the machine (shown in plain outline) transmits motion to the vertical table shaft, the lower end of which is enclosed in a hollow upright standard or post. The upper part of this post is again enclosed by the bearing of the horizontal arm, carrying at its further end a small vertical shaft with the two flanged pulleys. The lower part of the upright standard is enclosed by the bearing of the guide for the cutter bar. This guide is provided with suitable friction rollers, so as to give the cutter bar an easy, yet a perfectly steady and accurate horizontal motion. The front end of the cutter bar is formed into a round handle, which rests on the wooden guide, supported by two short columns near the front of the machine.

The cutter head works between two slides, which are bolted to the cutter bar. The vertical cutter spindle is hollow, containing the clamping device for the cutter; the milled nut on top of the cutter spindle is for the purpose of clamping and releasing the cutter shown at the lower end of the spindle. The small handle on top of the cutter head is for the purpose of setting the cutter to any desired depth.

The manner of transmitting motion to the cutter is plainly shown in the illustration, and needs little description. A light lever engages with the underside of the cutter bar; the fulcrum of the former is hidden by the latter, as shown in the illustration. The purpose of this light lever is to move the cutter bar to and fro in its guide. This lever can be adjusted so as to obtain more or less purchase; it can also be quickly moved into any convenient position on the underside of the cutter arm while the machine is running.

The work which is to be routed is held in the vise, one jaw of which is shown near the underside of the light lever. This jaw is quickly moved into any required position by means of the small hand-wheel shown behind it. The other jaw is hidden by the wooden cutter bar guide; it is used for clamping or releasing the work, and is operated by the handle projecting from under the edge of the table.

The operator, taking hold of the cutter bar handle with his left hand, and with his right hand taking hold of the light handle, has complete control of the movement of the cutter, and is enabled to guide it readily and accurately along any line drawn on the wood or metal which is to be routed. The guide for the cutter bar is pivoted, which enables the operator to lift the cutter sufficiently high to clear any of the raised surfaces, and thus move the cutter into other positions where routing is required.

This machine has, together with its requirements for general routing, the special advantage of cutting straight and parallel lines—a feature, it is needless to say, eminently valuable for many kinds of work. Quite a number of these machines are now in use, and, we understand, give excellent satisfaction, enabling the operator to rout very closely to the lines, and into the most intricate parts of the work, with precision and rapidity. These machines are manufactured by John Royle & Sons, Paterson, N. J.

Business and Mechanical Ability.

It is often a misfortune to men engaged in the machinery and engineering trades, either that their knowledge is confined to the purely business part of it, or that they are mechanics pure and simple. Our contemporary, the AMERICAN MACHINIST, has some remarks on this subject which are interesting and worth perusing. The combination of the two qualities in a proper degree is not frequent, and we thoroughly agree with our contemporary, that the possession of them in one man gives that person an advantage in conducting an engineering business, which will stand him in good stead. The moral of this appears to be that the training of a youth should be of a more all-round character than is usually the case now. The well-to-do parent often desires his son to attach himself to the professional side of the business, because it is more select, and the youth, consequently, is apt to look down on the department worked by the mere clerk. This is decidedly a mistake. We could recall instances where the despised clerk has, by force of his business training and acumen, made his way side by side with a clever engineer, until the latter has found himself at last under the direction and employ of his former despised rival. It would seem to be the case that a clever business man can push even an article of mediocre merit, and succeed in making it "go," where a mechanic, who knows he has a good thing, will fail utterly. The business man has studied his public, and knows how to buy and sell. He recognizes the value of advertising, and how to put his goods in a taking way before customers, satisfying himself with an average quality of work which will leave him a profit. On the other hand, the mechanical man studies his machine, and knowing its merits, satisfies himself that the world will be bound to recognize its superiority. It is difficult for him to believe that a really good thing needs to be pushed, and he finds, perhaps too late, that his machine is neglected in favor of a more widely pushed but inferior rival.—*The Machinery Market* (London).

LETTERS FROM PRACTICAL MEN.

Boring that Cylinder.

Editor American Machinist:

Mr. Platt's letter, in your issue of Jan. 17th, seems to invite suggestion as to the reason why the end of the cylinder last bored should be larger than the first end. I don't think it is a case of elliptical boring, and that subject is well explained in the same number, so it is useless for me to try to say anything about it. From the way that Mr. Platt's bar was mounted it is fair to assume that the center could not have been much out of line. If it were $\frac{1}{8}''$ out of the way with that bar I can only figure a difference of .00001″ in the two diameters of the ellipse.

But suppose the cylinder to have been bored first with a heavy cut and pretty well heated, and then the last cut started before the cylinder was allowed to cool. If the last cut was very light, as it should be, we may suppose that the cylinder cooled down considerably while the last cut was going through. Then the end first bored must be smaller than the last end by just the amount that the cylinder cooled and contracted during the boring. A reduction in temperature of 50° would give .003″ in a 10″ cylinder, an amount large enough to be readily detected by the calipers of the average machinist. I assume that the cutter bores a perfect hole of uniform diameter the whole length of the cylinder, but that the whole cylinder is 50° warmer at the beginning of the last boring than at the end of it, so that the end first bored cools 50° more after boring, and contracts .003″ more after boring, than the last end of the cylinder does. Any difference in the bore traceable to this cause could, of course, be avoided by allowing the cylinder to cool all night and starting the last cut the first thing in the morning.

The other cause, helping to produce a result such as Mr. Platt speaks of, I do not know how to eliminate. When the cutter is started on the last boring, it is either a new cutter or it has been taken out and re-ground. In either case, of course, as it begins the cut it is cold, and it naturally warms up and expands as it cuts, so that, from this cause also, the cylinder will be larger at the last end. The cutter naturally warms up very soon, and by the time it has gone in two or three inches it is probably as warm as it will be, and the small bore at the end will mostly be removed by the counter boring.

If Mr. Platt measured the bore of the cylinder immediately after the cut was finished, of course the last end of the cylinder would be the warmest, and consequently the largest. It should be measured in cold iron—and in cold blood.

If the *first cut* through the cylinder showed the bore at the last end larger than at the first end, which I cannot believe, then the case must be a desperate one, and my argument from the cooling of the cylinder does not apply, and I offer with fear and trembling another explanation that will certainly fix it. Supposing the bar to have a single cutter, as Mr. Platt seems to say—although I may remark that seems a slow and expensive way to bore cylinders—why might not the side of the bar where the cutter was, become hotter than the other side of it? So far as the bar was heated by radiation from the interior of the cylinder, it would heat uniformly all around; but so far as it was heated by conduction from the cutter, it would certainly be heated the most at the side nearest the cutting end of the cutter, and any mechanic can see that, if that side of the bar became elongated by heat, the bar would be thrown out of truth—more or less—toward the point of the cutter, and the cutter would

necessarily bore larger. A little difference in the heat of the two sides of the bar could make a very perceptible difference in the boring.

If I had that bar and I found that it was playing such a trick upon me, I would go in for having a little fun with it. As soon as one cut got through the cylinder, and before the bar had time to equalize the heat in it, I would start another cut in the cylinder with the cutter at the other side of the bar. I flatter myself I would be able to bore a very peculiar cylinder. One only gets a chance to do such jobs as that on paper generally. FRANK RICHARDS.

Photographing Patterns.

Editor American Machinist:

The following plan for keeping track of patterns does the business:

Spread a white paper on the floor, lay patterns on it in proper order, place on each pattern a small square of white paper on which is printed a *black, plain* figure, beginning with one, two, three, etc.; these may be cut from an old calendar, or painted purposely. Directly over the patterns suspend by any suitable means a photographic camera, and you have it. From the negative thus obtained, make two blue prints, send one to the foundry, and the old problem of marking patterns is not only solved, but lost patterns are much more easily found; for a pattern, unlike an actress, resembles its photograph every time. STERLING ELLIOTT.

A Convenient Level.

Editor American Machinist:

In erecting small stationary engines (from 12 to 40 horse-power) we were troubled a good deal in leveling the crossheads. The bearing was so narrow that we could not level it without using a very short spirit level, which was unhandy as well as inaccurate. So we got out a piece of iron of sufficient height to clear the guide-bars and sides of the frame, on top of which we used a longer level. This was also troublesome and unsatisfactory. I therefore determined one day to take the time and make a level for the purpose, which I did as follows:

Take first a piece of brass of the proper width to suit your bearing, and of the requisite dimensions in the other directions, to suit the surrounding circumstances.

Next, take a piece of iron or steel (preferably the latter) of about $\frac{3}{16}$ of an inch in thickness, and say 12 or 14 inches in length, the longer the better, and in width about one-half inch less than the brass piece at one end, and the other end tapered to about an half inch, the taper commencing at a distance from the large end equal to the thickness of the brass. In the small end saw a slot with the hack-saw, about a quarter of an inch deep. Then plane a slot in the brass piece, equal in width and depth to the steel piece at the large end, and at the same time plane a V in the brass of sufficient size to suit the wrists to be leveled.

Fasten the steel to the brass piece in the slot with screws, as shown in sketch.

Tie a knot in the string of a plumb-bob so that it will hang clear of the wrist-pin, and then place the tool on a shaft. Make a mark on the steel where the line hangs. Turn the level around, and mark it again in the same manner as before. Exactly half-way between these two marks make a third mark, and with this mark as one point, and the slot in the top as the other point, make a plain mark the whole length of the piece. At the bottom of this line, with a three-cornered file make a small notch, and your level should look something like the sketch.

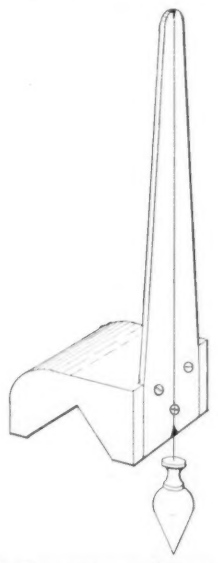
The principle of this tool is as "old as the hills," but if having been borrowed very often is any recommendation this must be an excellent tool, because it is very seldom that it can be found in its proper place when wanted. SHEPPERD MALLORY.

Charlotte, N. C.

Finding the Area of a Circle.

Editor American Machinist:

The article by Mr. W. E. Crane on "Mental Processes," in your December 31st issue, calls



A CONVENIENT LEVEL.

to mind a very simple way of finding the area of a circle, which may be found on page 79 of Reed's Engineers' Hand Book, 11th edition, and although it may not be considered exactly as a mental process, yet it may be so done; and it possesses this advantage over Mr. Crane's, "it is exact," as nearly as the constant .7854 can make it. For the benefit of those who have not the book, I will copy an example:

The diameter of a circle is 3.5", find its area.

3.5"	12.25"
3.5	.7
175	8575
105	8575
12.25" =	17150
	17150
	9.621150"

The square of diameter = 12.25 which we multiply by .7, as in simple multiplication. We then write this same product under the first, but removed one place to the right instead of the left, as in ordinary multiplication. This line is now multiplied by 2, and its result put down one place to the right, and again one place to the right, when the addition of the four lines will show the same result as if multiplied by .7854 in the ordinary manner. The process will be rendered clearer if we go through the process of multiplying 1 by .7854, thus:

1
7
–
7
7
14
14
.7854

CHAS. S. BEACH.

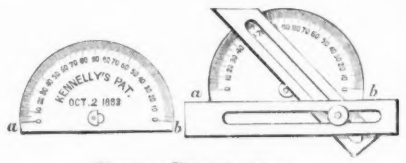
A Simple Decimal Weighing Scale for Experimental Use.

Editor American Machinist:

I enclose a sketch of a new scale I devised lately, for the purpose of subdividing small quantities of substances into decimal parts (of an ounce, for instance), for experimenting on a small scale.

In the sketch, *A* is a thin piece of board $\frac{1}{2}$"x4$\frac{1}{2}$"x22", supported near the front end in a notch cut into a piece of board (*L'*), about $\frac{3}{4}$"x6" in length. Another piece (*L*) is nailed near the tail end, as shown. The steel spring scale *U* is simply a piece of the steel rib of an old umbrella, made fast to the board *A* by two blind slat staples *o o'*, driven through the distance piece *B*, $\frac{1}{4}$" thick x 2" long, $\frac{1}{2}$" wide. The nail *N* over the top of the leg *L*, driven into the board *A*, is the bearing for the spring *U*, and serves the purpose of regulating the vernier *V*, by driving said nail in or out. The fine wire hook *W*, is hooked into the hole *K* in the spring *U*, and has a triangular stirrup with hexagonal base *H*, as a pan made of drawing paper hung to its lower end. *P* is a piece of paper pasted at the front end of the board *A*, on which is drawn the comparative scale *S*, divided into 10ths. *V* is a vernier fastened to the end of the spring *U*, having its ten divisions equal to nine divisions of the scale *S* as usual; thus it is easy to read to the $\frac{1}{100}$ part of an ounce (4.395 gr.)

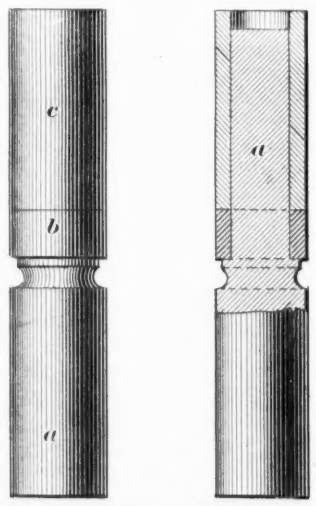
To graduate the instrument: Hang the wire hook *W* with pan *H* attached, into the hole at *K*, also paste a piece of paper of required dimensions for the vernier *V* to the end of the spring *U*; draw a line across the vernier and paper *P* at *o o*, making this the zero line; then place a one-ounce weight (or any other small weight) in the pan *H*, the spring will



BEVEL PROTRACTOR.

bend accordingly. Now draw a line on the paper *P*, coinciding with the new position of the zero line of the vernier, divide the distance between the last and the first line on *P* into ten equal parts, making the scale *S*; divide a certain distance below to extend the scale downward, say five divisions, or any convenient number.

Having taken the weight off the pan, the vernier will rise again to zero as at first; now



SUBSTITUTE FOR REAMERS.

make a line on the vernier to coincide with the ninth division on the scale *S*, divide the vernier *V* into ten equal parts, and the trick is complete, ready for work. Not patented, free to all. A. E. DUPAS.

New Orleans, La.

A Substitute for Reamers.

We illustrate with this a tool invented by a mechanic who, at the time, was employed in a prominent sewing machine factory, where he was responsible for the tool work. It is a broach which is intended for finishing round holes to standard size, instead of using reamers for that purpose.

It consists of a stud (*a*), made of steel, hardened and ground to size, the lower portion being slightly smaller than the finished size of the hole to be broached, while the upper part is made smaller, and receives a steel collar (*b*), which is also hardened, lapped or ground out to fit the stud accurately, and its outside diameter at its lower end made equal to the size of the hole to be broached, tapering slightly to the upper end. Above this is placed a steel sleeve (*c*), which is also accurately fitted to the stud, and ground slightly smaller than standard outside. In use, the parts are put together, as shown, and the lower portion of the stud (*a*) put into the hole, which has been previously drilled or bored to admit it. It is then put under a regular broaching or other press, and driven through, the result being a hole remarkably true, smooth, and close to standard. The annular groove in the stud gives room for the chips, and when the edge of the collar (*b*) becomes dulled, it is sharpened by grinding across the face. Since these collars can be made at a very slight expense comparatively, they are easily renewed when reduced below the desired size by this grinding.

It is not yet determined just what the limits are with regard to the size of holes which can be thus broached, but it has been quite extensively used in the sewing machine shop referred to, for broaching the holes in the hand-wheels, which are about $\frac{7}{16}$" diameter. So successful was it for this purpose, that the use of reamers was abandoned on that job, and a broaching press built for the purpose. The only object, in the first place, was to provide something easily renewable when reduced below size, but in practice it was found that a far greater number of holes could be broached within the allowable limit of variation with a single collar than could be reamed by the best reamer, the number of hand-wheels broached to standard size with a single collar being a matter for astonishment. Of course, for small work a light hand press will answer, as, in any case, the amount of metal removed is very small.

Though we have seen one of the tools, we had no opportunity of seeing it in use, but if the claims made for it are realized (and we have no reason to doubt them), it may work a revolution in the method of sizing small holes, where large numbers of them are made. The tool has recently been patented by Mr. Geo. Thompson, 286 Kosciusko street, Brooklyn, N. Y.

A New Bevel Protractor.

The accompanying cuts show a tool, by which any machinist, or other mechanic possessing a bevel square, can also readily have a bevel protractor.

The cut to the left shows the tool by itself, while the one to the right shows its application to a bevel protractor.

It consists simply of a plate graduated to degrees, and having at the center a stud which fits a hole in the plate and turns freely therein. The end of this stud, which projects on the graduated side of the plate, is cut away just to the center, as shown, and by applying this flat side of the stud to the blade of the bevel square, as shown, and then turning the blade to the proper graduation, the stud adjusts itself to the blade, which is thus set to the desired angle.

It will readily be seen that this tool, accurately constructed, and used in connection with a good bevel square, will be very convenient, and also capable of securing very accurate results, as well as making a tool, now used for one purpose only, useful for an additional purpose.

The tool is made by the Crescent Tool Works, Bridgeport, Conn.

S. Ashton Hand has accepted the position of superintendent for the Ferracute Machine Co., Bridgeton, N. J.

DECIMAL WEIGHING SCALE.

Halsey's Portable Power Drill.

The accompanying engravings show the construction, and a few of the special applications, of a new portable drill, which is driven by power, has an automatic feed, and is intended to be used in any position where ratchet or other portable drills can be used, possessing some distinct advantages in the facility with which it can be adjusted to any desired position, and in the rapidity and accuracy of the work it is capable of doing.

Fig. 1 shows the appearance and general construction of the tool. The lower part of the frame is cylindrical, threaded externally, below; has a hole in the center, in which steel bushings may be placed to guide the drill when desired, and openings in the sides, above the bushing, through which the action of the drill may be observed and chips removed.

Above these openings, and below the bevel gears, is an arm, which is bored to fit the frame, which at that point is turned true to receive it, and to which it can be clamped in any desired position. This arm carries the shaft to which is attached the sheave pulley and bevel pinion for driving the spindle. By loosening the clamp-screw under the bevel gears, this arm may be swung round to any desired position; or to the one in which the rope used for driving can be most conveniently led to the pulley.

The outer and larger bevel gear does the driving, and is connected with the spindle by a feather key. The smaller bevel gear is attached to and drives a sleeve (shown extending above it), which is internally threaded, and has, inside of it, another sleeve, the lower part of which has a thread upon it, which fits the thread in the first mentioned sleeve. The upper end of this inside sleeve is provided with a clamp collar, shown, by which it can be clamped to the spindle, seen extending above. The two bevel gears, with their pinions, are so proportioned that, when the pinions revolve together, the smaller bevel gear revolves faster than the larger one. Thus the outer sleeve is driven faster than the inner one, and the spindle to which it is clamped, and from this difference in their motion, and by means of the threads referred to, the feed is obtained. The smaller pinion is fixed upon the end of a shaft, which passes through the driving shaft, and can be made to turn with it, or disconnected at pleasure, by a clutch, part of which is shown outside the driving pulley. When this clutch is disconnected the two sleeves revolve together, and no feed takes place, while, by placing the hand upon the projecting end of the smaller shaft, its motion can be arrested, and the drill run up. The spindle is a straight, plain shaft of steel, without a shoulder, and, by loosening the clamp, it can be pulled out at the top to change drills, or to grind the drill in use without removing it from the spindle. It can be fed continuously a distance of six inches, when the clamp can be loosened, the sleeve run up and again tightened for continuing.

Fig. 2 shows the drill in use for drilling the holes in the end of an engine bed, by which the cylinder (of the over-hanging type) is attached. For this purpose a template is made, having holes through it, which, instead of being bushed, are tapped to receive the thread cut on the lower end of the frame of the drill, the bush being inside. Supported in this way the strain put upon the drill has no tendency to spring it out of square, since the question of leverage, and the strength of supporting arms, etc., need not be considered. The thread is made coarse, to give it durability, and to make its application and removal easy and quick.

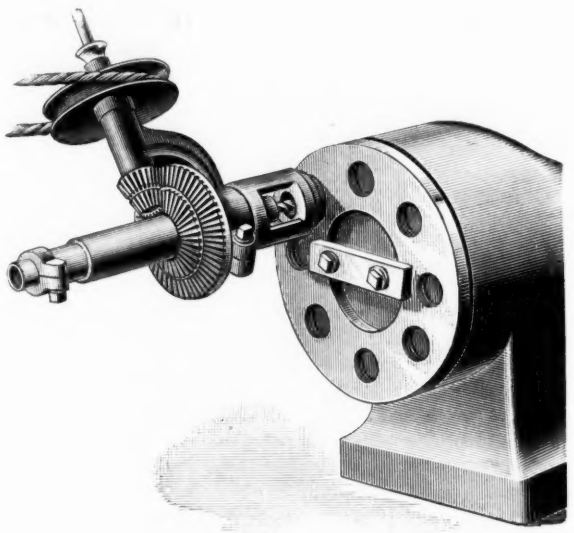


FIG. 2.

FIG. 1.

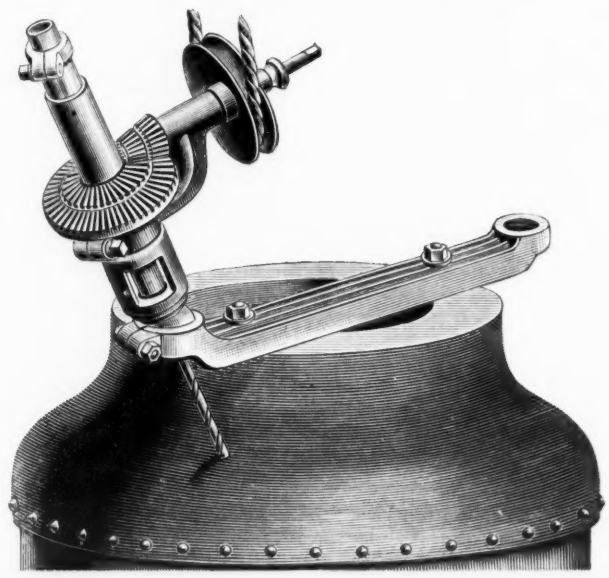


FIG. 3.

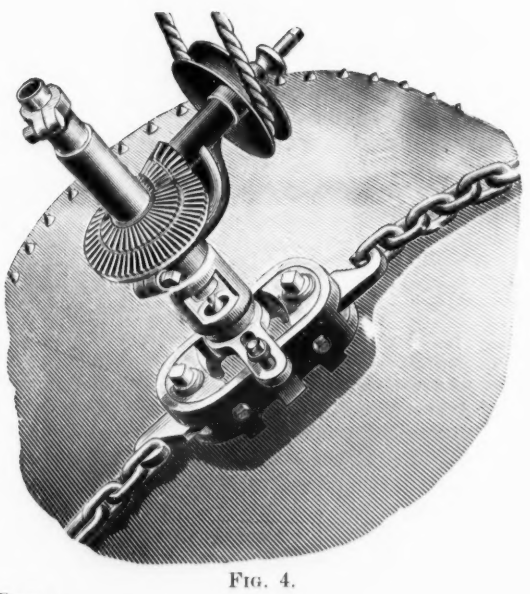


FIG. 4.

HALSEY'S PORTABLE POWER DRILL.

Fig. 3 shows its application to the dome of a locomotive, and how, by the use of a special clamp, it can be made to drill at any angle to the surface to which the clamp is attached. An enlarged view of this clamp is shown below, one end being partly in section, to show the universal joint, which consists simply of a portion of a sphere, tapped to receive the drill, and capable of being clamped at any angle. The opposite end is tapped square.

Fig. 4 shows it in use with another special clamp for drilling holes in the shell of a boiler. A chain passes around the boiler, and is attached to the two hooks shown. These hooks are held in place by eccentric studs, to which a wrench can be applied, and the chain readily loosened for shifting and adjustment, when a turn of the wrench tightens it. A movement of 2½" in any direction is provided for, which permits the drill to be precisely adjusted to position after the chain is tightened. Ordinary plain clamps of bar iron can be made in the shop, where the drill is to be used, and adapted to almost any job, such as drilling set-screw holes in pulleys, and many others which will readily suggest themselves. A number of the machines are in use in a prominent locomotive shop, where they are doing a large variety of work in a very efficient manner, some of which had not been considered possible except by the use of ratchets.

The machine weighs, complete, 50 lbs., and is provided with all the necessary fixtures for driving it by the rope in any possible position, such as inside the front end of a locomotive, in the pits under erecting floors, or on bridge work. It will drill up to 1¼" holes, a larger size being made to drill up to 2" holes, with 8" continuous feed.

The drill is manufactured by J. J. McCabe, 121 Liberty street, New York city.

Some Interesting Figures.

The Engineer (London), speaking of steamships and the power developed by their engines, says:

"It is a very easy matter to talk of 18,000 or 20,000 horse-power; but few people, we think, realize what it means. The following figures may help them to form a conception of what the much despised practical engineer has to do and does. It is more than probable that the White Star boats being built by Messrs. Harland and Woolf will develop 20,000 horse-power. At least, so rumor says; for, rightly or wrongly, it is asserted that they will have each twelve boilers and seventy-two furnaces, worked with forced draft on Howden's system. Assuming that the engines will require 18 lbs. of steam per horse per hour, then 160 tons of feed water must be pumped into the boilers every hour, and 160 tons of steam will pass through the engines in the same time. In twenty-four hours the feed water will amount to 3,840 tons, occupying 138,240 cubic feet. A tank, measuring 52 feet on the side, would hold one day's consumption, or it would fill a length of 493 feet of a canal 40 feet wide and 7 feet deep. Taking the condensing water at thirty times the feed water, it will amount to 4,800 tons per hour—115,200 tons in twenty-four hours; or, for a six-days' run across the Atlantic, to not less than 691,200 tons, or 24,883,000 cubic feet. This would fill a cubical tank 295 feet on the side—a tank into which the biggest church in London, steeple and all, could be put and covered up. The coal consumed will be 400 tons per day, which would fill forty wagons. This will require for its combustion 8,600 tons of air, occupying a space of 222,336,000 cubic feet. It is impossible for the mind to take in the significance of these latter figures. It may help if we say that, if this air was supplied to the ship through a pipe 20 feet in diameter, the air would traverse that pipe at the rate of about 5.6 miles per hour. It will be seen that the circulating pumps and fan engines of such a ship have no sinecure."

In the United States there are more locomotive boilers than any other single class, and in one monthly report of explosions we find that only two of this class of boiler exploded, whilst during the same period there were no less than eight explosions of saw mill boilers. In the latter case thirteen persons were killed and eleven seriously injured. If there were really thorough means of obtaining statistics of the number of people annually killed and wounded by boilers run by incompetent men, the list would show a most appalling record of suffering and death.—*Mechanical Progress* (England).

A correspondent of *Engineering* refers to the rough usage of machinery on shipboard, and to the fact that the admirable manner in which American machinery is packed gives American manufacturers an advantage. He cites instances in which heavy castings from English houses are broken, and says: "Quite fragile castings, such as stoves (from American manufacturers), are delivered in perfect order, owing to the admirable packing."

The manner in which machinery is packed has a good deal to do with the shape in which it gets to its destination, and the shape in which it gets to its destination has a good deal to do with future orders.

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NEW YORK, JANUARY 31, 1889.

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Executions by Electricity.

There seems to be among the electricians, a quite strong sentiment against the employment of the "mysterious force" for the taking off of condemned criminals, though just why it should be so strongly objected to, for purely sentimental reasons, we confess we find it hard to understand; perhaps because we are not very sentimental.

By the usual old-fashioned method the force of gravitation is made use of, and yet we believe we never heard of any one objecting specifically to the employment of that particular force, simply because it was a beneficent or vitally necessary one. Neither have we noticed any protests from boiler makers or engine builders against the use of the power of steam in executions; and yet it is safe to say that the electricity which will be used will be nothing more than a form or manifestation of the power of steam, and we really cannot see why boiler makers and steam engine builders have not an equal right, on sentimental grounds, to protest against the use of steam-power for such a shocking purpose.

We suspect that it is this sentimental objection to the use of electricity for executions, which is largely responsible for the frequently expressed opinion by electricians, that it cannot be successfully employed for the purpose; that not enough is known of its nature, action, etc., to make its application sure and reliable.

"Where there is a will there is a way," is an old saying which is not always true, but it is true that where there is no will the way is not likely to be found. That a person who is in contact with the earth, or any body capable of receiving an electric current, is brought into contact with a wire which is transmitting a current for arc lighting, he will be instantly killed, has been demonstrated time and again, and is being constantly demonstrated.

We respectfully submit to those who are especially interested in electricity, that they may do far more effective work in preventing the force from being brought into ill repute by taking efficient measures to protect the innocent from its death-dealing power, than by attempting to convince people that it cannot be used for destroying the life of malefactors.

A Peculiar Safety Valve.

Amongst the numerous trade journals which have sprung up within a few years past, there is one called *The Safety Valve*, which has many pleasing features, one of which is its motto, at the head of the editorial page:

"'Tis not in mortals to command success;
But we'll do more—we'll deserve it."

And yet notwithstanding this motto, we find constant proof that *The Safety Valve*, like the appliance from which it derives its name, needs constant watching, and we are sometimes inclined to the belief that other mottoes might be selected for the head of its editorial page, which, if not more appropriate, might at least serve a useful purpose by being constantly under the editorial eye. There is one, for instance, which is quite familiar, and which has something to say about what "is the best policy," which we commend to the attention of our contemporary, in the sincere hope that its use may lead to certain reforms which our observation has led us to believe are necessary, before it can accomplish the good which it might otherwise. In our issue of Jan. 3 there were two short editorial articles, which our contemporary seems to have considered worthy of republication in its columns.

In one of these we paid a tribute to the self-sacrificing bravery of a locomotive fireman, and our contemporary appropriates and reprints it verbatim, without any credit whatever. But this, while it is bad enough, is a plain case, and without perplexing complications, which is more than can be said of the appropriation of our article on "The Machinery Trade," of the same issue. This, evidently, was not very carefully looked over before being reprinted—a fact which, while it shows a gratifying faith in our accuracy and reliability, gives rise to some complication which must inevitably prove very perplexing to the readers of *The Safety Valve*. This article, which, like the other, it reprints without credit, and as though it were original editorial matter, begins by saying: "Following our usual custom at the beginning of the year, we publish elsewhere in this issue letters from a large number of representative machinery manufacturers and dealers," and all the way through it constantly refers and calls attention to these letters. And yet, the readers of *The S. V.* will look in vain for the latter in its pages, and no doubt will be greatly puzzled by their failure to find them. Then, too, when we consider the circumstances, it must seem strange to them that *The S. V.* should speak in this manner of its *usual custom* at the beginning of the year, when previous to that time, it had seen only one beginning of a year, and would hardly be considered old enough to have accumulated a usual yearly custom. We hope that this blunder, if it does not cause our contemporary to abandon its practice of appropriating the work of others without credit, will, for its readers' sake at least, induce a more careful inspection previous to reprinting. The only plan we can think of for relieving them of what must be an annoying perplexity, is for our contemporary to send to each one a copy of our issue of Jan. 3, containing the original article and the letters referred to. The mystery will then be understood by them. Copies can be had at this office at the usual rates.

A correspondent, who is an engineer, writes us a letter which is so typical of many we receive, that we feel constrained to refer to it. He believes that he has two distinct plans by which he can, to great advantage, utilize the natural currents of rivers to drive machinery; and he complains that, after exhausting his means in tests to demonstrate the utility of his inventions, he can find no one of means who will even investigate what he has got. If this is true (he lives in a large city), it emphasizes the fact we have brought out before this, that the confiding public has been gulled by so many dishonest schemes, that it is not inclined to respond to the possessor of what may be really meritorious. We know of nothing an inventor can do, under these circumstances, but to persevere in his efforts to get some one to whom he is personally known, or to whom he can get letters of introduction, to give him a hearing. If he cannot succeed with those to whom he is known, it is hardly to be expected he will do so among strangers. But perseverance will generally bring success. The foregoing is based on general principles, and not upon any knowledge of the devices by which our correspondent expects to accomplish his purposes.

The daily press has given a good deal of space to the chronicling of the fact that James G. Blaine, Jr., the son of the eminent statesman, has entered a machine shop to learn the trade of machinist. We see no occasion for all the fuss that is made over the matter. There is no good reason why young Blaine shall not make just as good a machinist as young Smith or young Jones, that is, if he puts in his time to good purpose. It is certainly commendable in any young man to master the means of getting an honest living, and if young Blaine, or young Smith or Jones, aspires to become a mechanical engineer, there is no better path than through the machine shop. But they will all fail to find any "royal road." Favoritism, or rich or eminent fathers can be of little service to them. Hard work and hard study alone will count. We wish all three of the young men named eminent success.

It is evident dynamite, and perhaps other of the high explosives, are to play an important part in future warfare. The recent trial of the fifteen-inch dynamite gun, while not entirely successful in all respects, was sufficiently so to demonstrate that immense charges of dynamite can be hurled with precision to considerable distances, and with the certainty of bringing about an explosion against which any iron-clad afloat would be powerless.

But satisfactory as the present dynamite gun appears to be—for all the failures have been in details easily remedied—it is almost certain invention in the direction of using high explosives will not cease.

It is in reason to believe that the range of guns for such purposes will be increased—probably more than doubled—and that they will become indeed terrible engines of warfare.

It is argued, with a surface show of reason, that the rapid increase in productive capacity of nearly all our manufactories, and the starting, especially at the South, of hundreds of new manufactories, must inevitably lead to the production of more than can be consumed. This may possibly be so, but it will not be because of over-production, so long as some millions of people in the country have less of the things produced than they need to make them comfortable. There is little danger of over-production, if the people have plenty of work at fair wages. But if the work is largely done by those who come here to earn a few dollars to carry away with them—who spend almost literally nothing in the way of living—then the country is likely to suffer, not from over-production, but from under-consumption.

There is considerable ferment in England in regard to immigration. It seems evident enough that something must be done with the surplus population, but the general sentiment appears to be that the better class of labor shall not be sent away. In other words, the class that it is proposed to get rid of is that which cannot, in any times, get a living there. This would be an excellent stroke of policy, no doubt, but unfortunately neither this country nor British colonies want, nor are likely long to tolerate, such immigration. There has been too much of it already.

After all, it would not be strange if the Nicaragua Canal should be built before the Panama Canal is completed. The company that proposes to build it ask a charter from the United States, but have already secured a charter from the State of Vermont, under which, it is said, they propose to begin work if Congress refuses a charter. It is to be hoped the company will not get into the same kind of trouble the promoters of the Panama Canal have encountered.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(40) W. D., Hornellsville, N. Y., asks: When does a car brake hold the most—when the wheel is sliding, or when the pressure is just a little less than to bring about sliding? *A.*—The brake holds best when the friction is not quite sufficient to stop the revolution of the wheel.

(41) Dare, Baton Rouge, La., writes: Our water-works has a water tower 100 feet high and 15 feet diameter; the main pipes, say 8 inches diameter. Now, suppose we attach a 3-inch hose 150 feet long, with 1¼-inch nozzle, to a hydrant 1½ miles away, and another hose of the same size one block away from the tower, will the pressure be the same in both? *A.*—No; the friction of the water in the pipes will reduce the pressure in the hose which is furthest away from the tower. It is assumed that both hose are on the same level.

(42) J. F., New York, writes: Would you be kind enough to inform me which is a good book for studying the measurements, etc., of boilers and other similar machinery? I want to perfect myself in this special branch, and am therefore in need of a cheap good book (in German) where I can find all the calculations relating to boilers. *A.*—We are not sufficiently familiar with books on this subject written in German. But we believe you will need more than one book to master this subject, no matter whether they are written in German or English. For books written in the latter language see answer to Question 38 (last week).

(43) F. F.-F., Detroit, writes: I propose to put in a new flue boiler, 48 inches x 12 feet. How many horse-power will this boiler develop, steam pressure 60 pounds? *A.*—You do not state the number of flues. If it is a two-flue boiler, properly proportioned, we should rate it at about 18 horse-power. If it is a five-flue boiler, we should rate it at about 22 horse-power. 2. What size of chimney made of iron would this boiler require? *A.*—About 15 inches diameter, and 50 feet high. 3. What is your opinion of tubular boilers? I want a 40 horse-power boiler. *A.*—Tubular boilers are good boilers, and are probably the best boilers to use when the feed water is clean and pure. For 40 horse-power you will need a boiler 48 inches diameter, 14 feet long, with fifty 3-inch flues.

(44) J. B. W., New York, sends us a sketch of a tank. The sketch represents a tank made of two semi-cylindrical shells, put together concentrically, leaving a narrow space for steam between the two. The tank is about 120 feet long. Brackets are riveted to the sides of the inner shell, to receive bearings for a hollow shaft, through which also steam flows. It is stated that the tank is very uneven, and sprung as much as ¼ to ⅜ of an inch out of line; the brackets which receive the bearings are also rough. It is asked: How can I line up the shaft which extends throughout the whole length of tank? *A.*—It seems to us that the best way to line up the shaft is to set the bottom of the bearings to a parallel straight-edge and spirit level, using shimming pieces between the brackets and bearings wherever it is necessary to do so. In a lateral direction, set the bearings to a line stretched from end to end of tank. 2. The hollow shaft is made in sections, the couplings are made of cast-steel and form the journals; steam pressure in the shaft from 75 to 80 pounds. What material, under these conditions, is most suitable for the bearings? *A.*—Under the given conditions we prefer brass bearings.

(45) E. W. M., Du Quoin, Ill., asks: How can I find the diameter of a water plunger in a hydraulic pump to obtain a pressure of 4,000 pounds per square inch, with 60 pounds of steam and a 5-inch steam cylinder? Make the answer general. *A.*—The following calculations are based on the assumption that no levers are used between the steam cylinder and the plunger; in short, the plunger is a part of the piston rod. In the first place, deduct 20 per cent. from the given steam pressure, to allow for friction, and the power necessary to work the mechanism. Hence, the effective pressure on the steam piston will be 48 pounds per square inch. The area of a 5-inch piston is 19.63 square inches; and the total effective pressure on the piston will be

$$19.63 \times 48 = 942.24 \text{ pounds.}$$

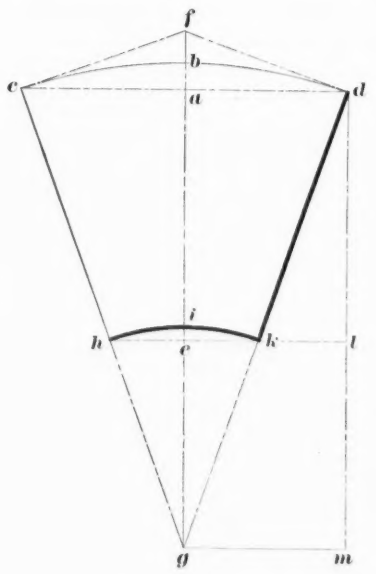
Now, in order to obtain a pressure of 4,000 pounds per square inch on the plunger, its area must be as much smaller than the area of the steam piston as 48 is less than 4,000. This gives us the following proportion:

$$4{,}000 : 48 :: 19.63 : \text{area of plunger.}$$

Hence we have

$$\frac{48 \times 19.63}{4{,}000} = 0.235 \text{ square inch,}$$

which is the area of the plunger. The diameter of a plunger having an area of 0.235 square inch is nearly 3-32 of an inch.



(46) J. D., Newport, R. I., writes: Please give me the rule for calculating the versed sine *a b* and also the radius for the arc *c b d*. *A.*—It is not correct to call the line *a b*, the versed sine; this line is the height of the arc *c b d*; and the straight line *c d* is the chord. From the tone of your letter, we assume that you wish to know how to lay out a tapered course for a boiler, or for similar shaped shells. The method for laying out such sheets we have explained in the answer to Question 306, June 23, 1888, to which we must refer you. In this answer we will simply give you the graphical method for finding the height *a b* of the arc *c b d*, and also a rule for computing the same. In practical examples of this kind, we usually know the length of the parallel chords *c d*, *h k* and the lines *d k* and *c h*, which are equal in length; hence, assume that the length of these lines are given; then to find the height *a b* of the arc *c b d* by a graphical method proceed as follows: Through the center *a* of the chord *c d*, and the center *e* of the chord *h k* draw the center line *f g*. Through the point *d* draw a line *d f* perpendicular to *d k*, cutting the center line *f g* in the point *f*. Divide the line *a f* into two equal parts, and thus obtain the central point *b*; the line *a b* will be the height of the arc *c b d*. This method of finding the height *a b* will only hold true for ordinary boiler work, or in cases in which the chord *c d* is at least equal to sixteen times the height *a b* of the arc. To find the height *a b* by calculation, we must know the radius *d g*. Assume, as before, that the lengths of the chords *c d* and *h k*, and also the length of the line *k d*, are known. To make our rule as plain as possible, we will first make the following construction: Prolong the line *d k* so as to meet the center line *f g* in the point *g*; through *g* draw the line *g m* perpendicular to *f g*; and through the extremity *d* of the chord *c d* draw a line *d m*, parallel to *f g*, meeting the line *g m* in the point *m*; the line *g m* will be equal to *a d*, that is, equal to one-half the chord *c d*. Prolong the chord *h k* so as to meet the line *d m* in the point *l*; according to the given conditions, *k l* will be parallel to *g m*; we may therefore state the following proportion: *k l* is to *g m* as *d k* is to *d g*. The length of the line *d k* is known; the line *g m* is equal to *a d*, which is given; and *k l* is one-half the difference of the two chords, and is also known; hence, to find the radius *d g*, we have the following rule: Multiply *a d* (that is one-half of the chord *c d*) by *d k*, and divide the product by *k l* (that is one-half the difference of the two chords *c d* and *h k*); the quotient will be the radius *d g*. When the radius *d g* is known, we find the height *a b* by the following rule: Square the radius *d g*; also square *a d*; subtract the latter square from the former one, and find the square root of the remainder; this square root will be the length of the line *a g*; subtract this length from the radius *a g*, the remainder will be the height *a b* of the arc *c b d*. Example: Let the length of the chord *c d* be 21 inches; the length of the chord *h k*, 9½ inches; and length of the line *d k*, 17 inches; it is required to find the height *a b* of the arc *c b d*. We must first find the radius *d g* by the proportion given. Now *k l* is equal to one-half the difference of 21 and 9½ inches, hence it is equal to

$$\frac{21 - 9\frac{1}{2}}{2} = 5\frac{3}{4} \text{ inches;}$$

and *a d* is equal to

$$\frac{21}{2} = 10\frac{1}{2}$$

inches; hence we have

$$5\frac{3}{4} : 10\frac{1}{2} :: 17 : \text{radius.}$$

Working out this proportion we have

$$\frac{10.5 \times 17}{5.75} = 31.04$$

inches, which is the radius *d g*. Now, the square of *d g* is equal to $31.04 \times 31.04 = 963.4816$; and the square *a d* is equal to $10.5 \times 10.5 = 110.25$. Subtracting the latter square from the former, we have $963.4816 - 110.25 = 853.2316$. The square root of 853.2316 is equal to

$$\sqrt{853.2316} = 29.21 \text{ inches,}$$

which is the length of *a g*. Subtracting *a g* from the radius *d g*, we have $31.04 - 29.21 = 1.83$, say 1⅞ inches for the height *a b* of the arc *c b d*.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.

Gear wheels and g-cutting. Grant, see adv., p. 16.

Link Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

"Swift" Sight Feed Lubricator; no glass tubes; simple, reliable. Swift Lub'r Co., Elmira, N. Y.

Power measured with guaranteed Dynamometers. Franklin Van Winkle, 91 Liberty st., New York.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Pattern letters and figures to place on patterns for castings. H. W. Knight & Sons, Seneca Falls, N. Y.

Selden Packing, for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Brown & Sharpe Mfg. Co. have a line of machinery with S. A. Smith, 23 S. Canal st., Chicago, Ill.

Dynamos, Engines, etc., need Common-sense oil filters; great saving. C. F. Baker, Minneapolis, Minn.

Ice and Refrigerating Machines, 131 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

"The Bulldozer," a new departure; forging by pressure. M'f'd by Williams, White & Co., Moline, Ill.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Automatic Wire Straightening and Cutting Machinery, Tools, etc. Manufactured by Collins-Gibbons Mfg. Co., St. Louis, Mo.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row, N. Y.

Upright drills, improved, sizes 21″, 23″, 25″, 28″, 32″, 36″ swing; finely made and great capacity. Currier & Snyder, Worcester, Mass.

Most sensitive and durable Damper Regulator made; works within one pound; send for circular. T. Kieley, 11 W. 13th st., New York.

Patents obtained. Patent litigation conducted. R. G. DuBois, Patent Attorney, 928-930 "F" street, Washington, D. C. Correspondence invited.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See Jan. 3, p. 15. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Fine tools and supplies for machinists and other metalworkers. Get our prices before purchasing elsewhere. Montgomery & Co., 105 Fulton st., N. Y. City.

See illustration of improvements in Hooks for Steam Engines, in Nov. 24 issue. For particulars address T. C. Dill Machine Co., 726 Girard av., Phila., Pa.

With my System, Exhaust Steam Heating costs nothing for fuel: Live Steam Apparatus altered to Exhaust. Satisfaction guaranteed. Geo. A. Barnard, 15 Cortlandt street, New York.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches, working drawings for the transmission of power by steam, water, air and electricity.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing grey iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N. Y.

The Vance Lightning Flue Cutter is *the* tool for removing old flues from boilers and locomotives (will cut fifty an hour); sent on approval to railroad companies. Vance Tube Cutter Co., Geneva, N. Y.

A system of easy lettering, by J. H. Cromwell, giving 26 forms of alphabets. The space to be lettered being divided into squares; simple and effective. Price 50 cents. Catalogue of books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N. Y.

Patterson, Jordan & Gottfried, 146-150 Centre st., N. Y. Metals, Machinery, Hardware, Tools and Supplies for Machinists, Mills, Engineers, Brass Goods Mfrs., Factories, etc. An extensive assortment of Bolts, Screws, Wire, Taps, Drills, etc., carried in stock.

Special facilities for the manufacturing of all kinds of light machinery, hardware and novelties, by contract or otherwise. Presswork and stamping done on short notice. Estimates furnished. Punches, dies and special tools made when required. Rockaway Mfg. Co., 3 E. 14th street, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

"Practical Drawing." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including Jan. 3, 1889 issue, 67 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 82 articles have thus far appeared up to and including the Jan. 10, 1889 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

MANUFACTURES

Ira Robins is building a machine shop at Sheffield, Ala.

J. E. Cox will start a foundry and machine shop at High Point, N. C.

William Coleman will build a steam saw mill at Clearwater, S. C.

The Cartersville Gas and Water Company will build gas works at Cartersville, Ga.

The Rife Hydraulic Engine Manufacturing Co. will establish works at Roanoke, Va.

The Dickson Car Wheel Works has been chartered, to manufacture car wheels at Houston, Texas.

Dilworth, Porter & Co., Pittsburgh, Pa., will build a machine shop, blacksmith shop, and foundry.

Sherwood & Taylor, of Middleport, N. Y., have begun the manufacture of brooms at Anniston, Ala.

The Universal Horseshoe Company are preparing to start in the manufacture of horseshoes at Anniston, Ala.

The Blair Manufacturing Company has been chartered, at Camden, N. J., to manufacture tools and machinery.

G. F. & L. G. Littlefield, the shoe manufacturers of Avon, Mass., who were burnt out in the big fire of July 14, will, it is now stated, soon rebuild on the same site.

The Goodyear Gossamer Company, of Hudson, Mass., have bought 14 acres of land, to locate new and larger buildings, their business having trebled the past three years.

The Fox Solid Pressed Steel Co. are building works at Joliet, Ill. The company will manufacture articles pressed from steel, under the patents of Mr. Fox, of Leeds, England.

The Stiles & Parker Press Co., Middletown, Conn., makers of presses, dies, etc., have been obliged to erect another addition to their works—the large number of orders which they have lately received, necessitating this extra amount of room.

The blooming mill engines for the Chester Rolling Mill Co., designed by William Tod & Co., of Youngstown, O., and now in process of construction, will be 30″x48″ cylinders, with piston valves, hydraulic reversing gear, piston throttle valve, and will have the frames rigidly connected together.

The New Doty Mfg. Co., Janesville, Wis., have issued a new catalogue of hand and power punching and shearing machinery, and boiler makers' rolls. They have added many new tools to their list since issuing their previous catalogue, all of which are illustrated in the new catalogue.

The shops of the Union Pacific Railroad, to be built at Cheyenne, Wyo., will, it is said, give employment to 2,000 men. It is reported that Denver offered $500,000 and perpetual exemption from taxation if the shops were located there. Cheyenne will expend something like $100,000 in the interests of the company, and furnish free water.

A delegation from the Mahoning Valley Iron Manufacturers' Association was in Pittsburgh, recently, and entered a protest against the advance in freight rates that went into effect January 14. They say the present condition of the iron market will not stand it, and it would likely result in the shutting down of all the works in the Mahoning valley.

The Fox Machine Co., Grand Rapids, Mich., write us: We are quite busy in our specialties [wood and iron-working machinery, low water alarms, etc.]; in fact, the last two weeks has shown a large increase of business. We have this fall moved into our new factory, which is 40x100 feet, two-story brick, and we are now in shape to prosecute such business as we have.

There is water-works agitation at Asheville, N. C.; Elizabeth City, N. C.; Clerburne, Texas; Franklin, Va.; Corpus Christi, Texas; Johnson City, Tenn.; Gainesville, Fla.; Valentine, Neb.; Waxahachie, Texas; Louisville, Ohio; Great Falls, Mont.; South Orange, N. J.; Sulphur Springs, Texas; Richford, Vt.; Greeneville, Miss.; Great Falls, Mass.; Ortinville, Minn.; Manchester, Conn.; Hull, Mo.; Argonia, Kan.; Palisades, Dak.

The town of Burnham [Me.] has a fine water-power, supplied by that immense reservoir, Unity Pond, with fall enough to carry any cotton or woolen mill in Maine, and there is almost a natural ledge dam on the site where a large tannery once stood. The town now owns this property, and by a unanimous vote offers to give it away to any one who will invest $10,000 in any kind of a manufactory, and also to exempt such factory from taxation for ten years. —*Industrial Record.*

The bulletin of the American Iron and Steel Association gives the following details of the production of Bessemer steel rails in this country: Total for 1888, 1,528,057 net tons; total for 1887, 2,290,197 tons. The decrease in 1888 as shown was 762,140 net tons, or 680,482 gross tons, which the bulletin says is greater than the total production in 1879, when 610,682 gross tons were made. The consumption of steel rails in 1888 was fully 750,000 gross tons less than in 1887, the imports in 1888 having declined about 77,000 tons from those of 1887.

Volney W. Mason & Co. (Friction Pulleys, Friction Clutches for connecting Shafting and Gearing, Hoisting Machinery and Elevators with Self-closing Hatches), Providence, R. I., write us: In reply to your inquiries, we have had an unprecedented year, fitting out the longest line of power hoisting apparatus sixty-one (61) hoists on the line shafting, 600 feet long—in the world, for the new and extensive hay sheds of the N. Y. C. & H. R. R. Co., at Eleventh avenue and 33d street, New York, the first part of the past year; have also shipped our elevators to Russia and Germany, besides having a very busy home trade for our elevators, hoisting machinery, friction pulleys and clutches.

The *Meriden* (Conn.) *Republican* says: Representatives of the Standard Oil company were in the city on Thursday, and purchased a lot of land, west of the Malleable Iron company's shop, between the Consolidated road and the tracks of the M. W. & C. R. Railroad. The company will immediately begin the construction of buildings and tanks on the property, and will endeavor to supply the city with oil. The kerosene stored there will be 150 proof test. It is also intended to furnish the stores with tanks, which will be filled from the plant up north, being brought down town by large tanks on wheels. The oil will be brought to the city by rail for the present. Another feature of the plant will be the building of a cooper shop, where barrels will be made, and this will be used as a shipping point, and it is expected that quite a business will be done in that line.

A Taunton (Mass.) correspondent writes: Business here is good. The Taunton Locomotive Mfg. Co. are working day and night (two gangs) to keep up with their orders on printing presses manufactured by them for the Huber Printing Press Co. Locomotive work is somewhat dull, although they have orders on hand now for about 11 engines, with prospects for more. Nothing has been done in the building of engines for the last six months; a few repair jobs have been received during that time. The Mason Machine Works are busy on cotton machinery. Printing press work with them is falling off somewhat. They manufacture presses for the Campbell Printing Press Co., of New York and Chicago. They are about starting on some narrow gauge engines (The Farlie) for the Boston Revere Beach & Lynn Railroad. There is a rumor that Messrs. Emery & Donnelly, formerly with the Campbell Printing Press Co., are about to commence business on their own account, making presses. They have received letters patent on an inking device for printing presses, and have now specifications filed for a complete printing press. The East Taunton Iron Works, which have been idle some years, are about to start up under new management, making wire for telegraph, telephone and electric light purposes. They are to draw their wire under a new process, for which letters patent were recently granted to Mr. Williams, of this city. The tack and nail business is rather dull just now.

Machinists' Supplies and Iron.

NEW YORK, Jan. 26, 1889.

Iron—American Pig.—The market still rules dull and weak, and concessions are usually made by sellers to secure business. Over-production is talked of, and a reduction of prices is not improbable. The nominal quotations are, for Standard brands No. 1 X Foundry, $17 to $18; No. 2, $16 to $16.50; Grey Forge, $15 to $15.50.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—See bottom of third column, page 11.

A graduate in machinery from a Dutch polytechnicum wants a position. Box 62, AM. MACHINIST.

Mechanical draftsman and machinist, vise hand, technical school graduate abroad, energetic, accurate, wants position as draftsman. W., 32, AM. MACH.

Wanted—By practical pattern maker and draftsman, position as foreman pattern maker. S. K., AMERICAN MACHINIST.

To Blacksmiths. Wanted—A locomotive frame maker to work by piece; steady employment. Correspondence invited. Blacksmith, AM. MACHINIST.

Experienced Foundry Foreman desires position, or will enter into a contract to make work by the ton. Heavy mach. preferred. Box 64, AM. MACHINIST.

Pattern maker with some capital wishes to make business engagement. H. W., 606 Cherry St., E. Saginaw, Mich.

Foundry Foreman wanted, for a small shop doing general work; must be a first-class, sober man. Address H. S. T., Poughkeepsie, N. Y., giving references and price.

Wanted—A Mech. Draftsman with some tech. education and exp. in High Speed Engine Design. Permanent position to right man. Address, stating experience, and salary desired, "Gregor," AM. MACH.

A mechanical engineer of 10 years' sea experience, with board of trade certificates, desires engagement as Supt. or Chief Engineer of large steam plant. Address Ability, AMERICAN MACHINIST.

Wanted—To make arrangements with a good house to trade with steam goods and special supplies; have had 14 years' experience; East or West; best of references. Address M., AM. MACHINIST.

Wanted—A few good bench hands to work on wood-working machinery; must have experience in the line, and none but first-class vise hands need apply. Address The Indiana Machine Works, Fort Wayne, Ind.

Wanted—Position as Supt. of Machine Shop after Feb. 1st, 1889. Fully competent; can handle men to advantage; 25 years' practical experience on various kinds of machinery, tools, fixtures, etc. Best references from former employers. Dallas, AM. MACH.

Wanted—A competent man as foreman of machine department in large works. Must understand engine work and be able to use indicator; also building special mach. and general work. Apply, giving references and experience, to C., care AM. MACH.

Young man wants position; thoroughly acquainted with Universal Milling Machine work, gear cutting, special cutters, etc.; also cutter grinding; lathe work if required; can design if necessary; sober and steady. Address Box 63, AMERICAN MACHINIST.

A practical engineer of 20 years' experience, having a design superior to the *best Corliss Engines*, wishes a position with responsible builders to design for them working drawings of his improvements. Address C. A. Condé, 1129 Cherry St., Philadelphia.

Wanted—By a first-class machinist, position as foreman, where ability will count; experienced at heavy hydrostatic machinery, marine, stationary and blowing engines; good draftsman; can handle men to best advantage; heavy work preferred. Address Competent, AMERICAN MACHINIST.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 15 cents per line, each insertion.

Gerlach's Engineers' specialties beat the world. Send for price list. Crescent Mfg. Co., Cleveland, O.

Crescent grease cup for shafting beats them all. Sample free. Crescent Mfg. Co., Cleveland, Ohio.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

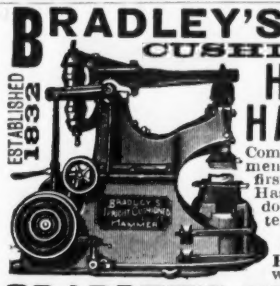
August C. Christensen, 24 State St., N. Y., consulting engineer for hydr. and pumping machinery, etc.

Punches, Dies and special machinery built to order. C. F. Langston & Co., 70 N. 4th St., Phila., Pa.

Correspondence solicited with parties having machine or foundry specialties to build. Honesdale Iron Works, Honesdale, Pa.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.



BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

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Combines the best elements essential in a first-class **Hammer**. Has more good points, does more and better work and costs less for repairs than any other **Hammer** in the world.

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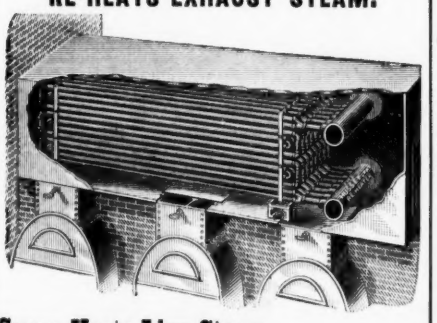

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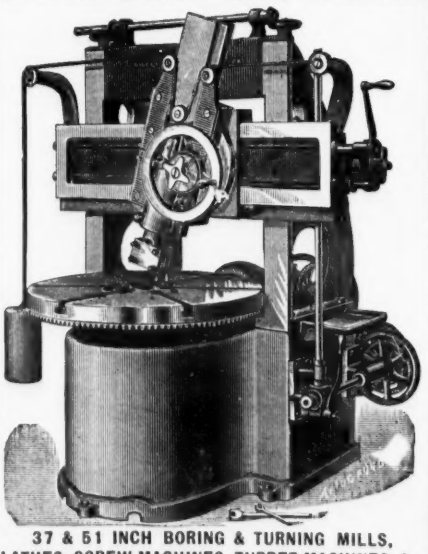

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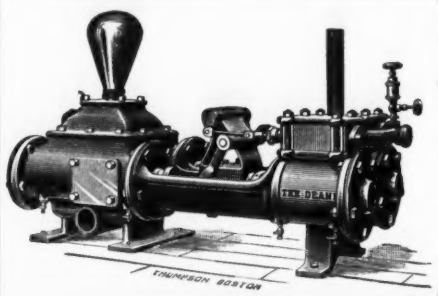

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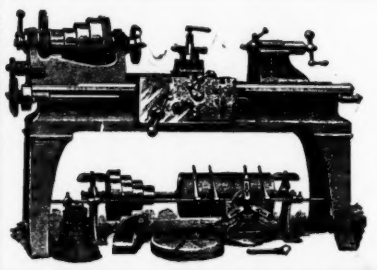

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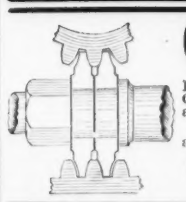

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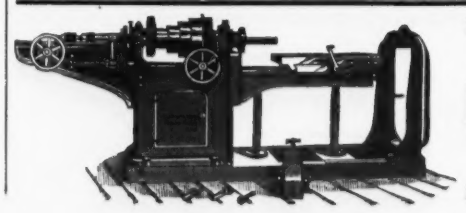

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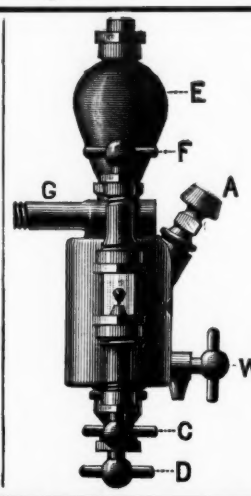

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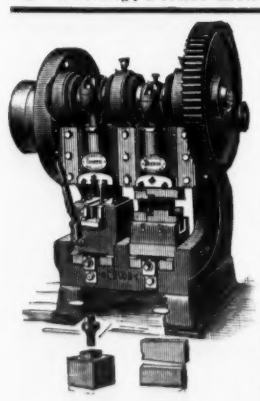

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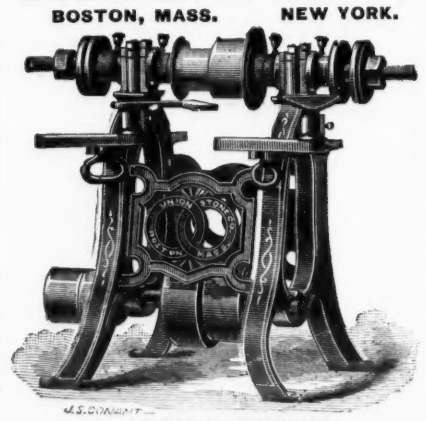

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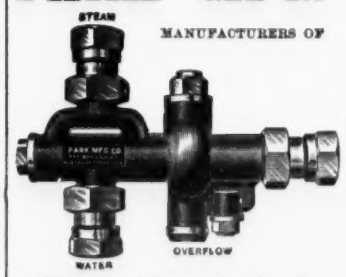

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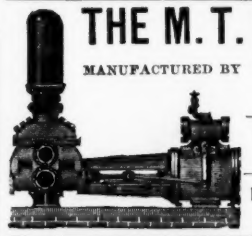

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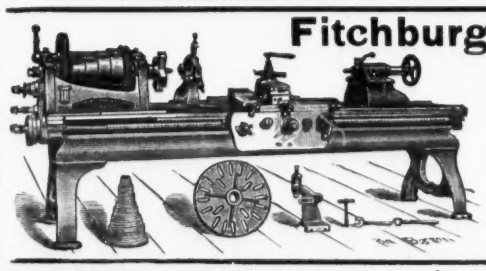

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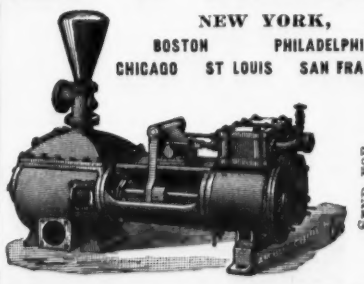

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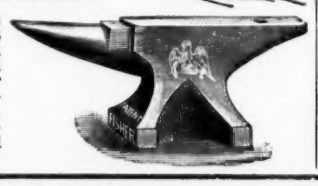

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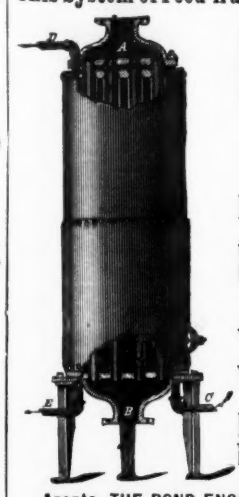

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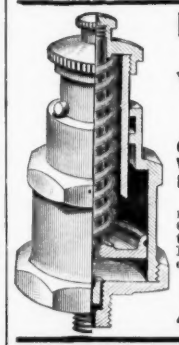

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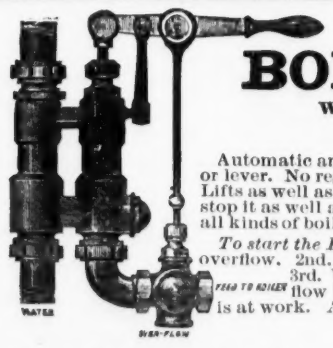

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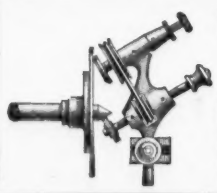

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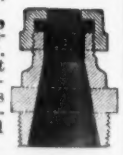

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24 in.	30 in.
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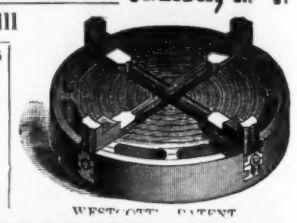

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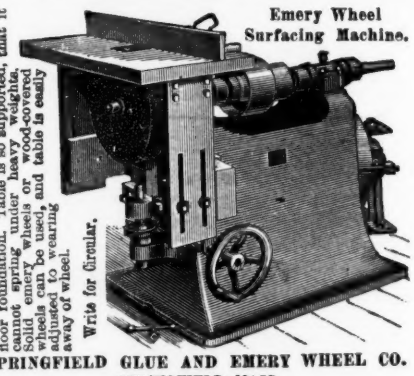

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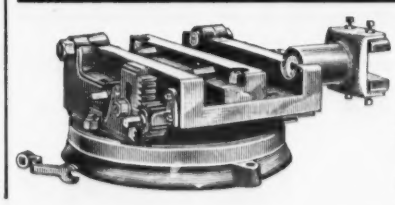

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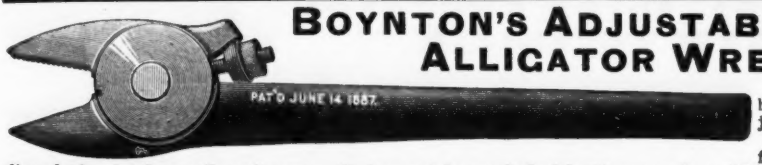

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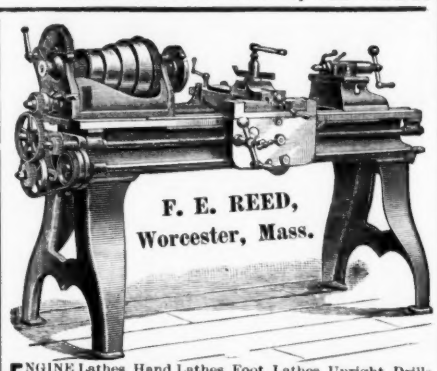

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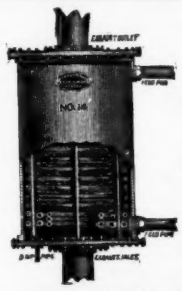

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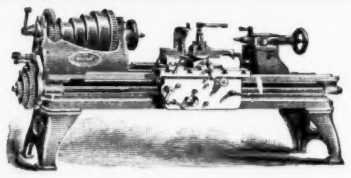

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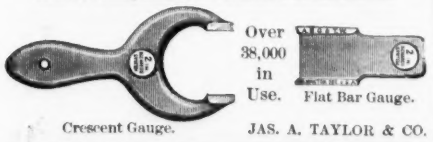

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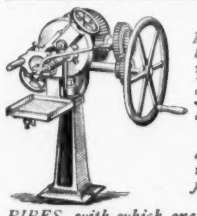

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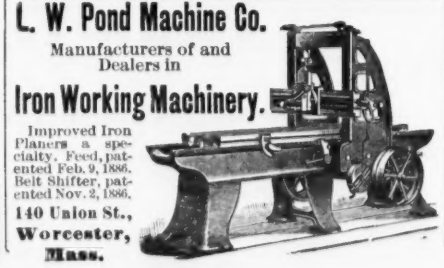

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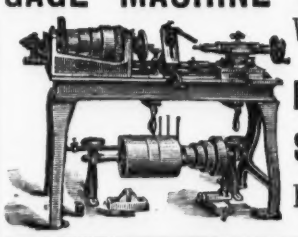

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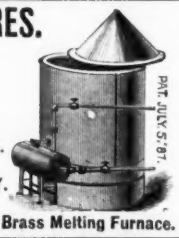

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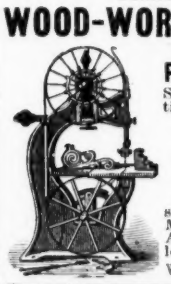

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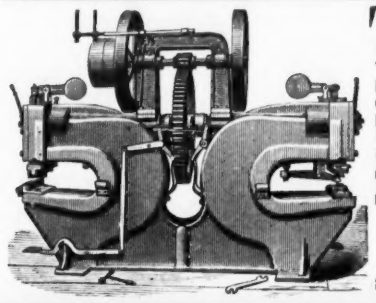

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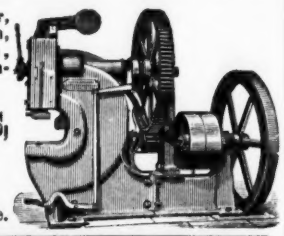

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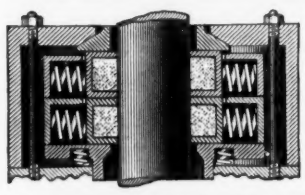

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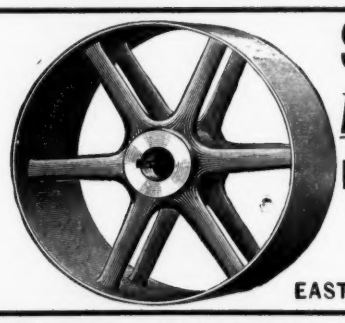

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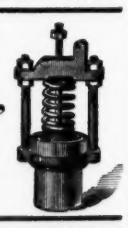

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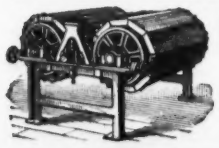

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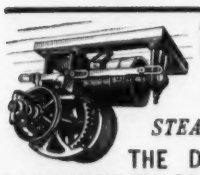

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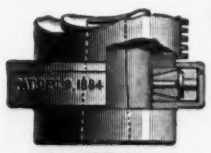

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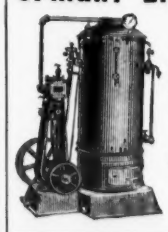

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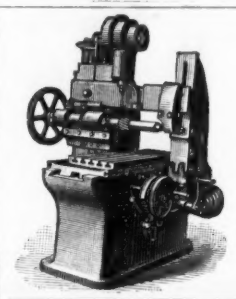

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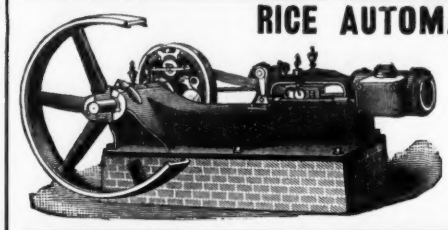

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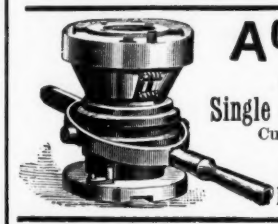

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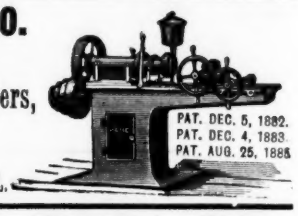

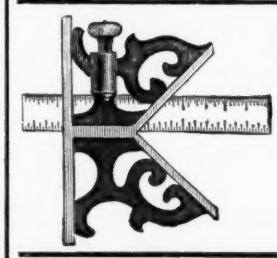

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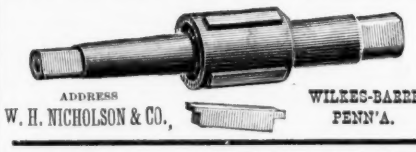

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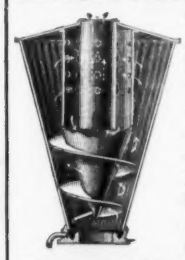

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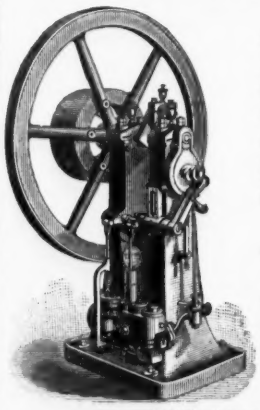

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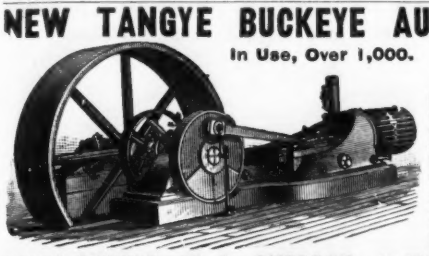

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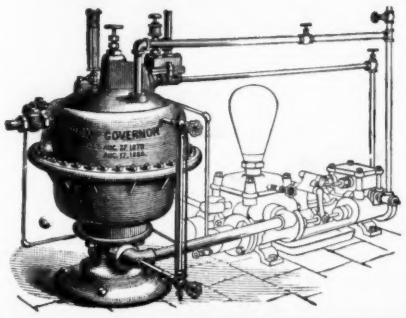

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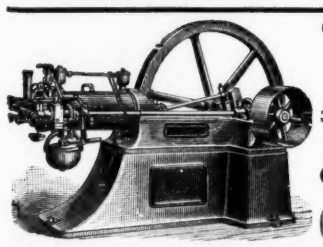

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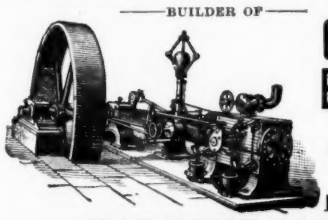

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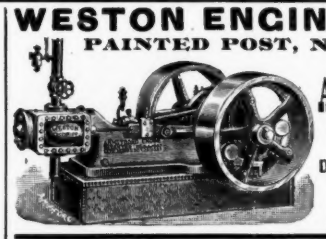

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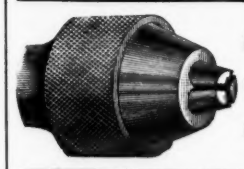

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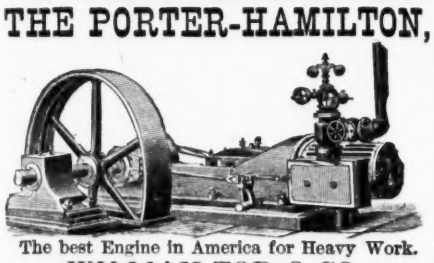

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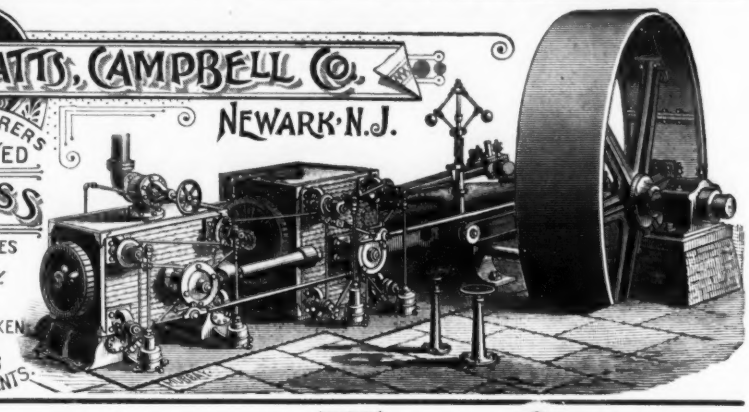

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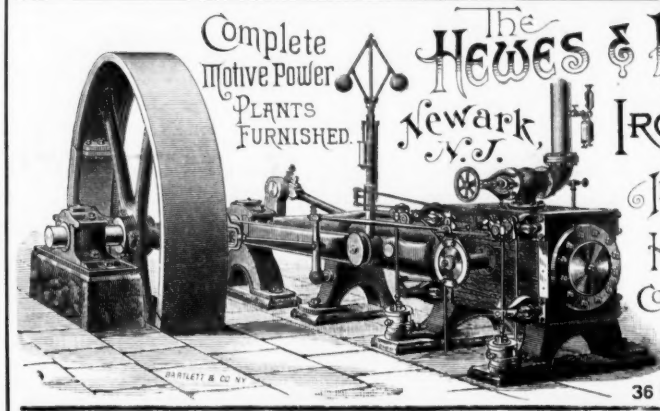

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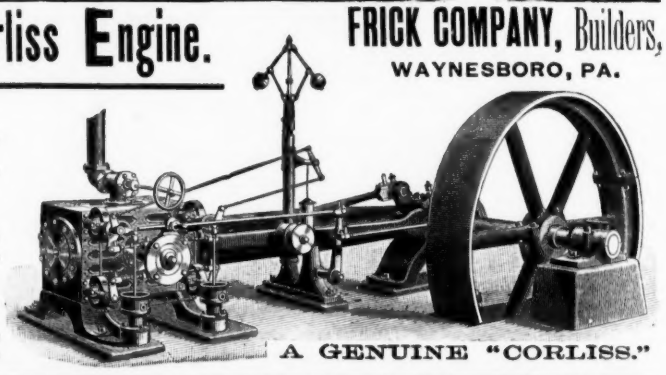

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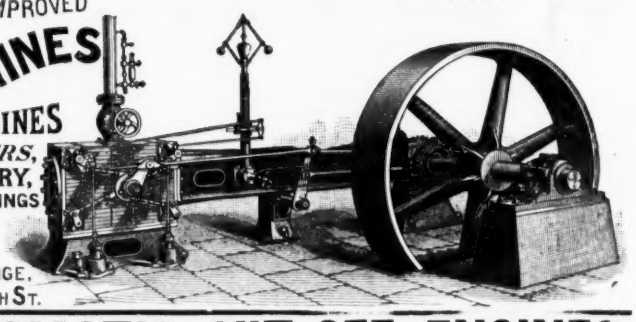

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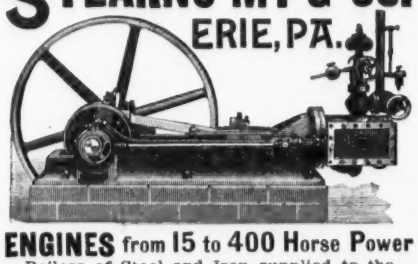

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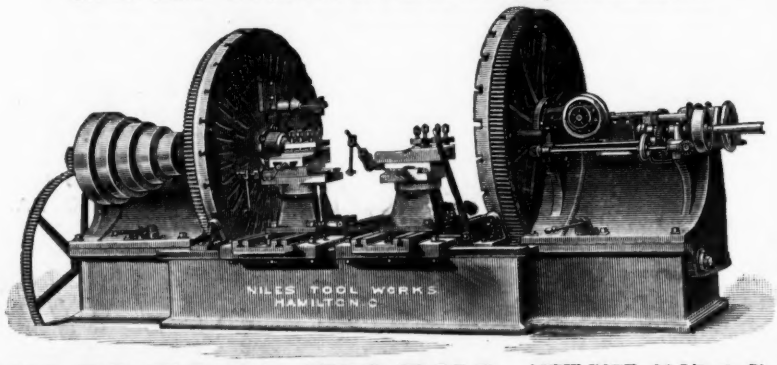

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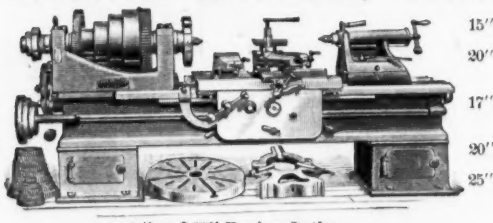

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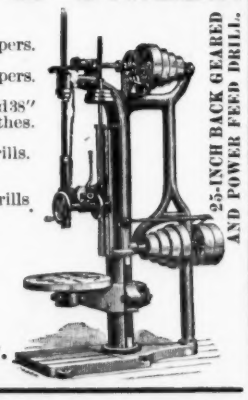

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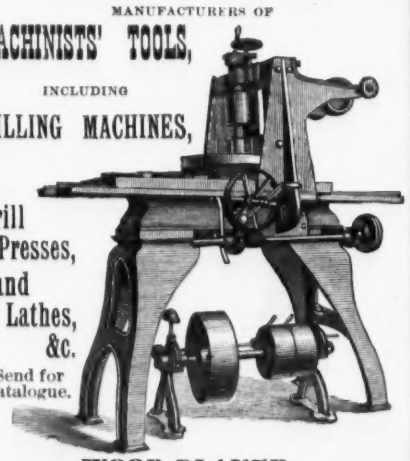

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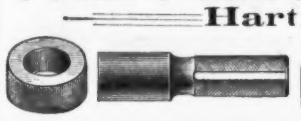

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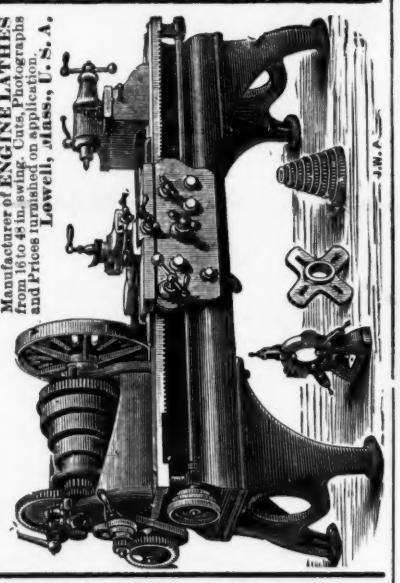

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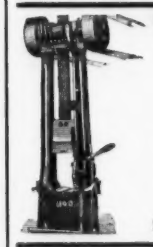

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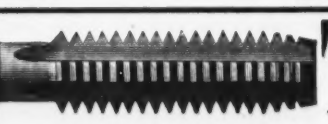

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